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DOMESTIC PESTS

WHAT THEY ARE AND HOW TO REMOVE THEM ?

By

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FOREWORD

THE famous challenge spoken in reference to preventable disease, " If preventable, why not prevented ? " might with equal force be applied to the great damage and depredations caused by domestic pests. They are preventable and therefore should be prevented. The author of this book is certainly helping housewives to take up this challenge. With her treble experience as zoologist, teacher, and housewife, Mrs. Hunter gives advice not only as to the best ways of preventing the entrance of the pests and of ways of getting rid of them, but in giving their life-histories she enables the housewife to adapt this knowledge to the special conditions of her own environment.

Some people are content to know only the " how," but others like to know the " why " as well. Both groups are well catered for in this book which, in its comparatively small compass, contains a large amount of information gathered from a wide range of knowledge, reading, and experience.

To save human beings from disease, and food, clothes, and furniture from contamination and destruction, is obviously a task well worth attempting. We may therefore wish a deserved success to the author and to her readers who, profiting by her knowledge and experience, keep their homes free from such pests and so share in a service of great value to the health and happiness of the community.

WINIFRED CULLIS.

PREFACE

THE subject of domestic pests, intimately bound up as it is with problems of food, health, and finance, is one of universal interest. Unfortunately the subject has not received the attention it deserves despite the advance of preventive medicine (particularly as it concerns public health), and despite the prominence given at the present day to housing, food preparation, and storage. The paucity of easily available information on domestic pests is scarcely consistent with the fabulous wastage of private and public money spent in repairing their depredations. Although there are a few simple and fairly cheap books on domestic pests, besides the very excellent British Museum (Natural History) Economic Series publications and excellent information in books such as Patton's " Insects, Ticks, Mites and Venomous Animals of Medical and Veterinary Importance. Part II, Public Health," and Esdaile's " Economic Biology. Part I, Harmful and Useful Animals," there is, as far as I can ascertain, no collection of data giving helpful information on all vital points connected with domestic pests. Two books which most nearly approach this are American publications, viz. Herrick's " Insects Injurious to the Household and Annoying to Man," and Metcalf and Flint's " Destructive and Useful Insects "; but since these are confined to household insects they omit some of the most prevalent pests.

This book is intended as a means of giving, under one cover, all the essential information regarding all pests, both animals and plants, which invade the home. The need for information about household pests has been brought home to me with some force by reason of my many contacts with housewives and students of all classes. As lecturer in charge of hygiene at a Domestic Science Training College where teachers and housewives are trained; as a lecturer in biology for many years to Adult Education and University Extension Classes; as a housewife myself, and as one having first-hand knowledge of reconditioned property, I am thoroughly convinced of the need for guidance in the matter of obtaining information about domestic pests. It is in this belief that I have written this book.

I have endeavoured to write the book in simple language so as to be easily comprehensible to readers with no scientific knowledge. On the other hand the text is so arranged that a scientific reader can make the fullest use of the bibliographies which appear under the description of each pest. Whilst every effort has been made to make these bibliographies comprehensive, it has been impossible to include all the standard entomological and botanical works of reference, since the purpose of this book is limited in its purely biological outlook. Such works as Imms's " General Textbook of Entomology " and numerous other standard texts have been omitted from the lists of references. Thus it is hoped that the facts given in this book will be useful not only to housewives in the home, but to housewives in training; to students training as teachers, especially of domestic science; to welfare workers; to sanitary inspectors; to adult education students; and to members of the medical profession.

Of the several acknowledgments I have to make I wish especially to thank Miss Mary Kibart, to whom I am indebted for the numerous drawings she has executed in illustration of the text. My thanks are also due to Dr. Philippa C. Esdaile for permission to use some drawings from " Economic Biology, Part I " as a basis for some of my line drawings, and to Professor W. S. Patton for permission to use some drawings from " Insects, Ticks, Mites and Venomous Animals of Medical and Veterinary Importance. Part II, Public Health " as a basis for some of my line drawings; to the Parkes Museum (the Royal Sanitary Institute) for permission to adapt certain diagrams; to the Controller of H.M. Stationery Office for permission to use the table of comparison from the Ministry of Agriculture and Fisheries Bulletin No. 30 which appears on page 208; and to the librarian of the Imperial Institute of Entomology for the loan of literature. I also take this opportunity of expressing my thanks to the members of the Annie Eddison Memorial Scholarship Committee who, by awarding me the scholarship, encouraged me to collect the material necessary for the production of this book.

INTRODUCTION

THIS book is an attempt to help any housewife or mother to understand the why and wherefore of some very unwelcome guests which invade her home and which are a constant source of trouble, expense, and inconvenience, to herself and her family. I refer to certain animals and plants which invade every home periodically, causing harm to members of the family and to clothing, furniture, and property.

From time to time every housewife asks herself such questions as the following:—

Why have I got dry rot in my floors?

Why does my bread and jam go mouldy?

Why are my walls discoloured and have patches of "salt" on them?

Why are my clothes moth-eaten after being packed away, although there are no moths in my cupboards?

How can I prevent rats and mice invading my larder and spoiling food?

Why do flies swarm over the food and wander over crockery and window-panes in warm weather?

Why does some of my furniture become "worm-eaten" and riddled with little holes?

Why do cockroaches swarm over my kitchen floor at night?

Why do some children have lice and fleas living on them, and pass them on to my clean children?

Are those little silver fish-like animals which run about so quickly in my kitchen cupboard doing any harm? Why are they there, and how can I get rid of them?

Very few housewives who ask themselves these questions know where to turn for information and advice. So often reliance is placed entirely on an advertisement for a remedy which claims to get rid of this or that pest. This is often used quite blindly, with no real understanding of the whole problem of eradicating the pest completely from the home, and very often no permanent cure is effected. How much more effectively could such a remedy be used if only the housewife understood what the remedy she was using was trying to do to the pest, and how often could she do it at much less expense. Then, too, her near neighbours, due to lack of cleanliness and attention, may very often be encouraging the very pest which a vigilant clean housewife is trying to destroy. The cost of many advertised remedies, moreover, is prohibitive to many purses. Thus, due to ignorance, indolence, or lack of money, pests of one kind or another are found in practically every home. It is therefore worth while for every housewife to know where she can obtain information about the habits of these unwelcome animals and plants in order to prevent them settling in the home and on the person. Then, if by mischance they do so, it is of advantage to the housewife if she can turn to some book which, whilst giving a simple description and cheap remedy in terms which assume no previous scientific knowledge, also directs her to other literature where she may obtain all the known information about any pest and the methods for its destruction. This, in brief, is the object and method of arrangement of the present book. Since any useful book on this subject must use certain technical terms, the meanings of these terms are explained in a glossary (*see* p. 225).

A great deal of information on household pests and how to control them is scattered in books of diverse character. Some books are devoted especially to certain household pests and give suggestions as to their control. Other books refer to household pests incidentally, since the subject is not the main theme of the book; these books often describe the appearance and structure of a pest but do not suggest measures of control. Some of the more technical books give much detailed information together with excellent illustrations. Many of these sources of information have been carefully classified, and their contents, with special reference to the pest problem, is given in the lists of books under the description of each individual pest. It is not generally realized that these books are available to practically everyone through the lending library system in all towns and villages. The majority of public libraries belong to a Regional Library System, and in the event of a book not being available in the local library it is the duty of the librarian to obtain it from the Regional Bureau or from the National Central Library. Only the cost of carriage falls on the borrower.

Attention is drawn to the seriousness of many of the more common domestic pests in the leaflets, pamphlets, and posters, published by some of the Health Societies. These very cheap leaflets endeavour to point out the principal characteristics and habits of the pest, suggest measures for prevention in the home, and show the connection with disease. The following are some of the Societies which print helpful leaflets, etc.:—

(1) Central Council for Health Education (1 Upper Montague Street, Russell Square, London, W.C.1), from which much useful advice on all matters pertaining to health can be obtained.

(2) Health and Cleanliness Council, Education Department (Tavistock Square, London, W.C.), which publishes " Hints to the Busy Housewife " and posters such as " Dirt is the Favourite Haunt of Flies."

(3) The People's League of Health (Stratford Place, London, W.1), which publishes such pamphlets as " Vermin and their Relation to Disease " (price 6d.).

(4) The New Health Society (39 Bedford Square, London, W.C.1), which has a lending library containing many of the simple books on pests, which can be borrowed by members of the Society. The Society also publishes very cheap leaflets on the subject of pests, for example " The Fly Menace," and also a monthly magazine, " New Health," which often contains articles dealing with pests in the home. The cost of this magazine is 1s., or 9s. annually.

(5) The Institute of Hygiene (28 Portland Place, London, W.1).

(6) The Institute of Microbiology (233 Pentonville Road, London).

Certain firms selling insecticides and vermin killers often give useful information on the habits of pests and means for their destruction. A few of these are appended.

(1) The Rodent and Insect Pest Destruction Co., Ltd., 69A Sancroft Street, London, S.E.11, have many slogans in connection with their advertisements and publish pamphlets such as " Some Common Domestic Pests " (6d.), and a book " A Practical Handbook on Rat Destruction " (3s. 6d.).

(2) Bayer Products Ltd., Africa House, Kingsway, London, W.C.2, give much information on such pests as rats and bugs in particular, in advertising their proprietary articles.

(3) Lawe's Chemical Company, Creeksmouth, Barking, Essex, publish catalogues which give many helpful hints on the use of insecticides.

Most Museums, Home-Life Exhibitions, etc., devote a section to the subject of public health, and stage exhibits depicting domestic pests. By means of models, charts, and actual specimens of common pests such as rats, houseflies, fleas, and bugs, their structure and life-history is illustrated, the diseases they disseminate are pointed out, the damage they do is explained, and methods of eradication are suggested. In London there is the British Museum (Natural History Section), Cromwell Road, London, S.W.7, which has exhibits in the main entrance hall and specimens in the classified departments of the museum; there is the London School of Hygiene and Tropical Medicine Museum which has a section devoted to questions of public health including much information on household pests, disease, and food; there is the Parkes Museum at the Royal Sanitary Institute, 95 Buckingham Palace Road, London, S.W.1, which devotes considerable space to domestic pests. The majority of towns have museums, many of which have specimens of different household pests. It is frequently the case that towns hold a " Health Week " organized by the local Personal Health Association in which all matters pertaining to questions of public health are brought to the notice of the public by posters, leaflets, lectures, and an exhibition.

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PART I

CHAPTER I

PESTS AND THE DEGREES OF HARM THEY DO IN THE HOME

THE MEANING AND SIGNIFICANCE OF PESTS

THE word pest originally meant some deadly disease, but we regard a household or domestic pest as some living thing that is troublesome and harmful in the home.

Man, in the establishing of his home, has really created his household pests, for animals and plants invade the home only as we give them opportunity. In the provision and storing of food, in the furnishing and equipment of our home, in the clothing of our family, we are also giving potential food and homes to animals and plants. Certain insects, rodents, and moulds, have linked their fortunes with man and have come to depend upon him in some intimate way for sustenance and protection. The capacity of these animals and plants to become pests in the home is no vice inherent in themselves, but is due to man's unwitting encouragement. If man creates conditions for adequate supplies of food, for rapid reproduction and increase in numbers for these animals and plants, then, if they gain entry into his home under such favourable conditions they very quickly multiply and become pests. It is therefore essential for a housewife to attend to the hygiene of her home and to realize the importance of cleanliness if she wishes to prevent pests establishing themselves in her home. She must frequently overhaul her goods, whether they be stores of food, clothes, furniture, or furnishings, thus becoming aware of any pest which may have found home and food in her goods. Scrupulous cleanliness in the home means early detection of a pest or the signs of it, before it has had time to multiply and so to do untold havoc. The housewife can exclude household pests from her home if she will only protect (cover) all food; frequently air furnishings and stored clothing, linen, etc.;

clear away immediately and not leave exposed any refuse; carefully scrub or polish woodwork; and attend to the ventilation of her home.

There is no doubt that inefficient housing, overcrowding, uncleanliness, and other violations of hygiene, tend to predispose a home to attacks from household pests. These factors, together with the crowding together of homes in many of our industrial cities, thus providing the pest with perfect travelling facilities from home to home, are largely responsible for the spread of such pests as rats, bugs, and lice.

The successful dealing with pests is not merely a matter of being able to recognize this or that harmful plant or animal in the home, but is essentially the ability to decide why this particular living thing is invading the home. It is important to know what conditions are favourable for the increase of some unwanted pest, for if these conditions can be made unfavourable the pest ceases to exist. For example, it is known that dampness and lack of ventilation are two favourable conditions for dry rot in wood; remove the source of dampness, provide adequate ventilation, remove all wood suffering from dry rot, and there is a reasonable chance that no more wood will be affected. Nor is it enough to use certain chemical insecticides to get rid of insect pests unless something is known about the habits of the pests and how such chemicals will affect other things in the home. Above all, it is useless to use any remedies to rid a home of a pest unless at the same time steps are taken to remove the conditions favouring its entry and spread.

THE VARYING HARMFULNESS OF PESTS

The many common household pests such as clothes moths, flies, rats, beetles, and bugs, which so easily gain entrance even to the cleanest homes, show varying degrees of harm as pests. This must be taken into account when considering their seriousness in the home and the measures necessary to keep them in check.

Some pests do harm in the home practically the whole of their lifetime. For example, apart from the first three weeks of its life when it is nursed and fed by its mother, the rat obtains its own food (usually ours) for the rest of its life. In gaining entry to our home it gnaws through our woodwork, and consumes much of our food and spoils more by the filth it leaves on it. The louse, one of our personal pests, also does harm to us during the whole of its lifetime, which it spends on the human body. On the other hand, other pests are actively harmful in the home only at one period of their life. This is so in the case of many insect pests; for example, the clothes moth does not injure our clothes in its adult stage, but only when it has just hatched into something more like a caterpillar than a moth. On the contrary it is the adult housefly which is the pest when it visits our food, crockery, and window-panes; and it is only the adult flea which spends its time on man, making itself a nuisance.

In spite of this, for the successful control of these and other household pests it is essential to know *all* their habits, especially as to their breeding places, so that they can be attacked by the housewife at a stage when they are most vulnerable, and not necessarily when they are actually doing harm in the home. There are some animals and plants, however, which cannot be universally condemned as domestic pests, since it is only if they are present in very large numbers that they are troublesome in the home. For example, such occasional pests as earwigs, wood-lice, and ants, enter the home accidentally and can usually easily be eradicated.

A lack of knowledge of the habits of pests may lead the housewife to fail to recognize the relative importance of the pests in her home. For instance, spiders and their webs are usually attacked vigilantly by a housewife because their presence indicates that the house is not scrupulously clean. But really the spider is not so serious a pest in the home as many others, particularly the housefly, which the housewife may tend to ignore and take no steps to exterminate. Knowledge of the habits of the housefly will enable the housewife to appreciate the unseen harm which this commonest of pests may do. It is nevertheless true that the home which is thoroughly and regularly cleaned harbours neither flies nor spiders nor any other pests.

The harm done by most pests is usually entirely disproportionate to the actual destruction of material, etc., which they cause. For example, the smallest piece of cloth (worth perhaps a few pence) eaten by a clothes-moth larva may render a whole suit of clothes practically worthless; fungus growing in one small patch on the wall of a room may entail the redecoration of the whole room; and a few lice on a person's head for one day may harm his social reputation. In the case of cockroaches and mice the amount of our food which they eat is quite insignificant compared with the amount they taint by their presence. On the other hand the amount of food consumed by the larger pests is considerable. It has been calculated that the grain consumed by five rats is equivalent to the bread ration of one human being.

Weather conditions and seasonal changes are known to have some effect on the activity of household pests. For example, whilst such pests as mice, cockroaches, lice, fleas, moulds, and bugs, are active during the whole year, others, such as flies and clothes moths, which favour warm and dry conditions, are more active in the summer months. Nevertheless, although the latter have not been evident they have been present in the home throughout the year, and knowledge of their habits will enable the housewife to deal effectively with them before their harmful activities begin.

A very sinister aspect of the pest problem is their rôle in the carrying of disease. Particularly responsible in this direction is the housefly, which has been proved to transmit at least three diseases to man. There is good reason to believe, although we have no definite proof, that many other pests intimately connected with ourselves and our homes are responsible for spreading disease. On account of these grave suspicions, we should regard all pests as potential sources of danger in this respect, and the housewife must therefore prevent *any* pest from infesting her home. Indeed, she must regard this as a duty no less important than any other in protecting her household against infection and illness.

CHAPTER II

THE KNOWLEDGE NECESSARY FOR THE SUCCESSFUL CONTROL OF DOMESTIC PESTS, AND IMPORTANT FACTS CONCERNING THEM

In all methods of control of domestic pests the housewife must know something of the habits and the mode of life of the pest so that she can expel it from her home. She must be able to take advantage of some vulnerable period in the pest's life when, by chemical, physical, or mechanical means she can effectively attack the pest, but at the same time know that she will not harm either members of her family, or food, clothing, furniture, or other equipment in her home. The housewife should know how to discourage the pest from gaining access to her home, but if entry does occur despite all precautions, she must know a quick and effective means of destroying it at the best time. The majority of domestic pests are silent workers, and in their daily activities of getting food, reproducing their kind, and moving from place to place, silence is their keynote. Usually the first thing to attract attention to the presence of a pest in a home is the damage resulting from its activities. But, as previously stated, frequent cleaning and overhauling of the home and its contents is the safest means of prevention of pests.

Some of the animals that enter our homes do so accidentally. They come in through an open window, or are attracted by a light, as in the case of moths at night. Such invaders of the home are not really pests for they do no harm, and it is only if present in large numbers that they may cause annoyance to the household. On the other hand, other animals come into the house with a definite purpose and, having achieved it, as does the blowfly when she has laid her eggs on meat, leave the house. Such animals are definitely harmful, as they spoil food and often bring filth from their other haunts. Some animals and plants spend the whole of their life inside the home or on members of the household. Although not doing harm during the whole of this time, these are the most formidable of the domestic pests.

There are certain essential features of the life and habits of pests that every housewife should realize when dealing with this ever-present household problem. She should be able to answer the following questions about any pest that is liable to invade her home:—

(1) What does it eat? How does it get its food? Does it eat the same kind of food throughout its lifetime?

(2) How does it get air so that it can breathe?

(3) How does it move about? Does it always move by the same method throughout the whole of its life?

(4) How does it multiply? Does it lay eggs and if so, where? Does it build a nest? Does it look after its young?

(5) At what time of the year does it do most harm, and when is it most vulnerable?

Above all, a housewife must know what proves attractive in her home to these unwelcome visitors so that she can make conditions as unfavourable as possible for them. She must realize that each pest has its own mode of entry into her home, such as flying in through open windows, etc. (flies), crawling in through minute cracks (bugs), on a person's body (lice, fleas), running in through doorways (cockroaches), blown in with dust (moulds), or via clothing (bugs), furniture (beetles and mites), and wood (dry rot).

It is important for a housewife to have prompt warning of a pest's invasion of her home, regardless of whether or not it is at a period in its lifetime when it might do harm. She should be able to recognize either the pest itself or the results of its handiwork. For instance, it is much easier to recognize sawdust caused by the larva (" wood-worm ") of a furniture beetle which eats wood than it is to find a furniture beetle flying about the house. Again, it is easier to see warped woodwork and uneven floors than it is to see the fungus that causes the dry rot responsible for this condition of the wood. Lack of knowledge causes many housewives to overlook any slight damage caused by the early visitants, and it is only when extensive damage has been caused that they begin searching for the cause of the trouble. It frequently happens (as, for example, in the case of the furniture beetle) that this delay has been responsible for the spread of the pest to other parts of the house. Knowledge of the habits of the pest would lead the housewife to expect this, and to take immediate steps to forestall it. The keynote in the treatment of pests is early detection of their presence, followed by immediate measures to destroy them and to prevent their spread.

CHAPTER III

SOME IMPORTANT CHARACTERISTICS OF LIVING THINGS WITH SPECIAL REFERENCE TO DOMESTIC PESTS

ALL living things, both plant and animal, require nourishment and water in order that they may grow and have energy to move about. Even though plants have no mouths they can take in water to support life, and green plants can make their food from substances they take in from the air and soil. Some plants which are not green, for example the moulds, depend on material that is or has been living for their food, just as animals do. Thus, all household pests need food and water, and in their search for these they may invade our homes for supplies. Some pests eat our food, others the furniture, furnishings and equipment of our homes, others our clothes, and some depend upon our blood. By knowing what food a certain pest likes, and by preventing it from getting that food, we have a sure means of suppression of the pest.

Then, too, all living things, animal and plant, must breathe for life to continue in them. The great majority of plants and animals have to be constantly supplied with air to prevent suffocation from taking place. It is the constituent of air called oxygen which is so necessary to living things, for this is the means of setting free energy and so allowing life activities to continue. If living things are deprived of air which contains the essential oxygen, then they die. Certain domestic pests can be exterminated by resorting to interference with supplies of air, since in some cases it is possible to block the entrances by which air enters the body.

An important characteristic of all living things, animal and plant, is the power they have to reproduce their kind, i.e. something like themselves which will live in the same manner as they did. Every kind of animal and plant has its own particular way by means of which it breeds and produces young. There is great variety in the methods of breeding among household pests, and so it is very important for the housewife to know the breeding habits of her pests, for the prevention of breeding means control of numbers. In many of the animal pests, the majority of which are insects, the female parent lays eggs which have been fertilized by the male. Each type of insect pest selects some particular place to lay her eggs: for example, the blowfly lays her eggs on meat; the furniture beetle on some rough unpolished wood. As a consequence of this there is usually no direct parental care, but the eggs are always left to hatch where there will be food when the new animal emerges. In other animal pests the female produces her young alive, and usually has made preparations for looking after them after birth. This is instanced in the rat, which makes a comfortable nest with stores of food, and nurses her litter of young for at least three weeks until they are mature.

In the case of some egg-laying insect pests the eggs hatch into miniature adults which are very similar to the parent. The cockroach and the louse are typical examples. A young cockroach emerges from the egg in a form very similar to the parent except for size and the absence of wings, but growth and development of wings take place gradually. Such an animal is said to have *direct development* and shows *incomplete metamorphosis*. In other egg-laying insects the egg hatches out into something quite different from the parent in appearance, mode of progression, type of food eaten, and habitat. The worm-like individual which emerges from the egg is usually called a larva, maggot, or grub. This creature grows and passes through a resting stage called a pupa or chrysalis before the adult insect emerges. The majority of our insect domestic pests have this type of life-history, which is often called *indirect development*, and they are said to undergo *complete metamorphosis*. Knowledge of the complicated life-history of some of these pests, for example the housefly, often reveals valuable methods of control.

Reproduction in plants takes place in several ways: by seeds which have been fertilized by pollen; by grafting; by budding; and by splitting. The moulds, some of which are household pests, such as the fungus which causes dry-rot in wood, do not produce flowers which make pollen and seeds, but instead make minute spores. These are blown about in the air and if they alight where there are favourable conditions of moisture and food they make a new plant, there being no need for spores to be fertilized like seeds.

It is therefore an asset if the housewife knows something of the habits of household pests and how they perform the important functions characteristic of living things, viz. eating, breathing, reproducing. She can then use this knowledge in devising means of controlling a pest in her home; for by depriving a pest of food, or by tempting it to eat poisoned food, or to breathe air poisoned by chemicals, it can be destroyed. It is also important to know how and where pests breed so that the breeding places can be constantly supervised and both eggs and young destroyed, and the female adult deterred from approaching a possible breeding place. To prevent breeding is to prevent pests in the home.

CHAPTER IV

MECHANICAL METHODS OF CONTROL

THE annual spring-cleaning done by the majority of housewives is usually the only time when there is a complete overhaul of everything in the home. Now this is an excellent institution, for it disturbs any eggs or pests that might be breeding, and gives an opportunity to get rid of those pests which are doing damage. The cleaning and all it entails means the destruction of those conditions favourable to the life of animals and plants which constitute our domestic pests. But very often this cleaning is done too late in the spring, after many pests have produced their young which have wrought damage in the home revealed at this annual cleaning. Thorough overhauling should be done more frequently, especially in the early spring when so many pests breed, and also in the autumn when many adult pests settle in some warm secluded place to spend the winter months. Knowledge of the habits of pests indicates a more thorough cleaning rather than the superficial cleaning which is done regularly in most homes.

Besides this general means of controlling pests the housewife should know of special means. These may be mechanical or chemical measures. There are several mechanical means of control which take advantage of a pest's mode of entry into the home, its food, and the conditions for successful breeding. To prevent certain animal pests entering the home in search of food or breeding places it is essential to guard entrances. For instance, larder windows need screening with gauze as a protection against flies; outlet pipes and ventilation openings need screening to prevent the entry of larger pests like mice and rats. Larders should be kept cool and dry in order to prevent dust-blown pests such as moulds from attacking stored food, and also to discourage mites and flour moths. Pets in the home, unless well cared for, are often responsible for introducing pests such as fleas and lice into the household.

During the construction of a house it is frequently the case that pests, both animals and plants, gain entry or, owing to faulty building, conditions favourable for the future thriving of pests are established. For instance, the fungus which causes dry-rot is often introduced during the building period, and in these days of speculative building, favourable conditions are made for this fungus to flourish. Inadequate sub-floor ventilation, places of access for moisture together with suitable temperature all encourage the development of this pest, with the subsequent irregular roofs, warping of woodwork, and uneven floors characteristic of it.

Since pests do so easily gain entry into the home the following mechanical means of control should be utilized by the housewife. All food should be covered as a protection against flying and crawling pests. An added precaution against the latter is to raise the food dishes out of reach of the marauder. The use of traps of all descriptions is an effective means of control if the utmost advantage of habits be taken in devising them. Since some pests, such as the housefly, breed in decaying material, it is essential to keep covered all garbage and household refuse (which should be destroyed daily), and also to attend carefully to the sanitation of the house.

In order to exterminate pests which attack wood, the frequent dusting and polishing of polished wood, especially those surfaces not touched in general usage such as the backs of furniture, and constant scrubbing of all exposed unpolished wood, whether cupboards, drawers, floors, or tables, is to be recommended. The most effective measures to be taken against pests which harm clothing and furnishings is to shake and brush the latter, especially those parts where dirt easily lodges and which are not frequently disturbed in their ordinary usage. Superficial brushing and shaking often leaves undisturbed eggs of pests such as moths until their larvæ have done their destructive work. In order to store clothing and furnishings safely, after careful brushing followed by cleaning or washing to remove any pests or eggs, they should be packed in paper, leaving no crevice or gap through which the smallest pest could pass, and the package should be stored in as cool and dry a place as possible.

CHAPTER V

PHYSICAL AND CHEMICAL MEANS OF CONTROL

It is known that exposure to extremes of cold or heat is fatal to all forms of life, whether plant or animal. The temperature of refrigeration (about 40° F.) is not usually sufficiently low to kill, but will suspend all activity, such as growth and breeding, until warmer conditions are restored. Control of fungoid growth on foods is thus effected by keeping it at as low a temperature as possible in a refrigerator or ice-box, though in the ordinary household the cost of this is usually prohibitive. Insect pests can be destroyed by exposing them to a temperature of 140° F., although this method is only feasible in the ordinary oven in the case of small insect-infested articles such as books, clothing, and small pieces of wood. The method is effective but not very satisfactory in the ordinary household because of the difficulty of attaining the correct temperature and maintaining it over a sufficiently long period to prove efficacious. There is also considerable danger of damage by burning. On the large scale, however, such as in the delousing of infested clothing where rapidity and absolute infallibility are essential, the heating method is of the greatest possible service.

It is much wiser for the housewife to resort to chemical means of control if her mechanical means have failed to check the activities of a pest. There are several fumigants and poisons that a housewife can use herself quite cheaply and effectively in dealing with a small influx of some pest. In using chemical insecticides it cannot be over-emphasized that all are poisonous to life, but that the poisonous action is only relative. In other words, any chemical insecticide would no doubt be fatal to household pets and even man if taken in sufficiently large doses, but the majority of domestic pests are so small that only a small dose of an insecticide is necessary to kill them; such a dose would have no ill-effect in such small quantities on larger animals and man. Chemicals vary very much in their intensity as poisons; for example, arsenic and hydrocyanic acid gas are extremely poisonous, whereas pyrethrum powder and naphthalene are only mildly so. It is for this reason that there is legislation controlling the sale of such materials as arsenic preparations and cyanides, as they are unsafe for an inexperienced person to use. A housewife should know of their existence as infallible insecticides, however, and realize that they can be used by calling in experienced help from the local authority if a serious infestation of some pest occurs, for example, the bug. Indeed, in using any chemical whatever in the home, great care must be taken to confine its use as far as possible to the pest so as not to harm members of the household, pets, food, or fabrics. Liquid chemicals such as carbon tetrachloride and orthodichlorbenzene are often recommended as insecticides since their vapours are such excellent exterminators of all pests. Although the sale of these substances is not restricted they should only be used by experienced persons who realize the danger of constantly inhaling their vapours and take the necessary precautions. A list of chemicals, with prices and particulars, suitable for use by a housewife in dealing with pests, is given at the end of this chapter. They can be purchased at any chemists.

Chemicals can be used in different ways to attack pests. Some of them merely act as *repellents* and deter the pest from approaching that part of the home where the chemical has been introduced. The odour from certain volatile substances seems to be so obnoxious to certain insects that they keep away from the vicinity of these substances. Naphthalene, camphor, cedarwood, are the best-known repellents, but it must be remembered that they are only effective in a closed cupboard or box, and that their power as a repellent only lasts for a limited period owing to their volatile nature. Other chemicals are so potent that they destroy the pests by actually poisoning them. They can be made to do this destructive work in a variety of ways. Some chemicals are used as *stomach poisons* and for their application advantage is often taken of the preference shown by most pests for certain kinds of food. Into this food is introduced some chemical insecticide and the poisoned food is used as bait, quite often in conjunction with a mechanical trap. For instance an attractive bait to flies can be made of formalin (the poison), sugar (the attractive food), which also counteracts the repelling effect that the formalin may have, and a little weak alkali such as lime-water to neutralize any acids. This fluid is put in a mechanical trap devised so that flies suck some liquid and then die. Other stomach poisons are not used in conjunction with a mechanical trap but advantage is taken of the mode of progression and habit of cleaning themselves in certain insects. Running nocturnal insects such as silver-fish and cockroaches become covered with dust or powder as they move about, and they tend to swallow it in cleaning themselves. Advantage can be taken of this by putting poisonous powders such as pyrethrum powder and sodium fluoride where these creatures wander. A mixture of three parts of sodium fluoride and one part of pyrethrum powder is efficacious. Also since cockroaches and silver-fish eat sugar and flour, chemicals such as pyrethrum powder, sodium fluoride or borax can be mixed with chocolate, flour, or sugar, and left where the insects are known to wander in their nightly maraudings. Some of the stomach poisons can also be classed as *contact poisons*. This is because certain insecticides are brought into contact with the pests in the effort to destroy them. These liquids very often contain the same active principle which destroys the pest, as in the case of stomach poisons. For instance, formalin and pyrethrum powder are both stomach and contact poisons according as to whether the pest eats or comes in contact with the chemical, or at any rate with the volatile portion which is the real destructive agent. These liquid contact poisons are often sprayed in the vicinity of the pest so that the insecticide does its work. Spraying is difficult to make effective in cases such as the fungus which lives in plaster of walls, and the furniture beetle which tunnels deep down in wood; in such cases the only effective way of getting the insecticide in contact with the pest is by application of the liquid with cloth or brush to the surface of plaster or wood and allowing it to soak in.

Of all the contact poisons the spray made of pyrethrum powder and pure white paraffin is the one most recommended. Pyrethrum powder (also known as Persian insect powder, buhac, and Dalmatian powder) contains a volatile oil which is poisonous to insects, and forms the basis of the majority of the insecticides on sale. For use as a spray the powder is mixed with paraffin, when the active principle passes into the paraffin, which is then sprayed in the vicinity of the insect pest. Owing to the volatile nature of the active principle, the liquid spray should be kept tightly sealed. The spray is made of 8 oz. pyrethrum powder to 1 gallon of pure white paraffin, and to make the smell less unpleasant to members of the household a small quantity of methyl salicylate can be added. Formalin, a solution of magnesium silico-fluoride, paraffin, turpentine, creosote, are all examples of insecticides which can be applied by brush or cloth to floors, shelves, and walls. The two first are effective in destroying the fungus which grows in damp walls of a room; the three last are useful in destroying pests such as wood-boring beetles.

The third group of chemicals which destroy pests are in the nature of *respiratory poisons*, so called because they cause destruction by entering the breathing system. They are poisonous gases or fumigants which are suitable for use in places which can be completely closed for twenty-four hours. Most fumigants, such as hydrocyanic acid gas, must be used only by trained experienced persons, but there is one fumigant, sulphur dioxide, which the housewife herself can use in a serious insect infestation. This gas is generated when sulphur burns in air. First, all cracks and crevices must be sealed up with old rags or gummed paper, the chimney must be carefully blocked, and door and windows sealed. All metal goods must be removed since sulphur dioxide fumes would tarnish them; foodstuffs must be removed from the room since many of their qualities would be destroyed. It must also be realized that wallpaper and coloured fabrics will tend to be bleached by the action of the gas. The sulphur (about 3 lb. for a room 12 ft. square) in the form of rock sulphur or sulphur candles, must be placed on a metal tray and all precautions taken against the possibility of fire in the room before the sulphur is ignited. The fumes must be allowed to circulate in the sealed room for at least twenty-four hours.

CHEMICALS USEFUL IN CHECKING HOUSEHOLD PESTS

Chemical	Description	Price		
		s.	*d.*	
Alum	Crystalline lumps		5	lb.
Benzene	Liquid		8	lb.
Borax	Powder		4	lb.
Camphor	Lumps	4	0	lb.
Carbolic acid	Liquid	1	4	lb.
Carbon bisulphide	Liquid		10	lb.
Carbon tetrachloride	Liquid	1	0	lb.
Castor oil	Liquid	1	6	lb.
Castile soap	Solid		8	lb.
Creosote	Liquid	1	3	gall.
Eucalyptus oil	Liquid	2	4	lb.
Formalin	Liquid	1	0	lb.
Lime water	Liquid		2	pint
Linseed oil	Liquid	3	9	gall.
Lysol	Liquid	5	6	gall.
Magnesium silicofluoride	Powder	1	9	lb.
Naphthalene	Flakes		5	lb.
Orthodichlorbenzene	Liquid	1	6	lb.
Paradichlorbenzene	Solid	1	8	lb.
Paraffin oil	Liquid	1	0	gall.
Pyrethrum powder	Powder	2	0	lb.
Resin	Powder		10	lb.
Sodium fluoride	Powder	1	3	lb.
Sulphur	Candle		6	lb.
Turpentine	Liquid	6	0	gall.

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Parasitology.
Public Health Reports.
Review of Applied Entomology, Parts A and B.
The Sanitarian.
U.S. Bureau of Entomology, Technical Bulletins.
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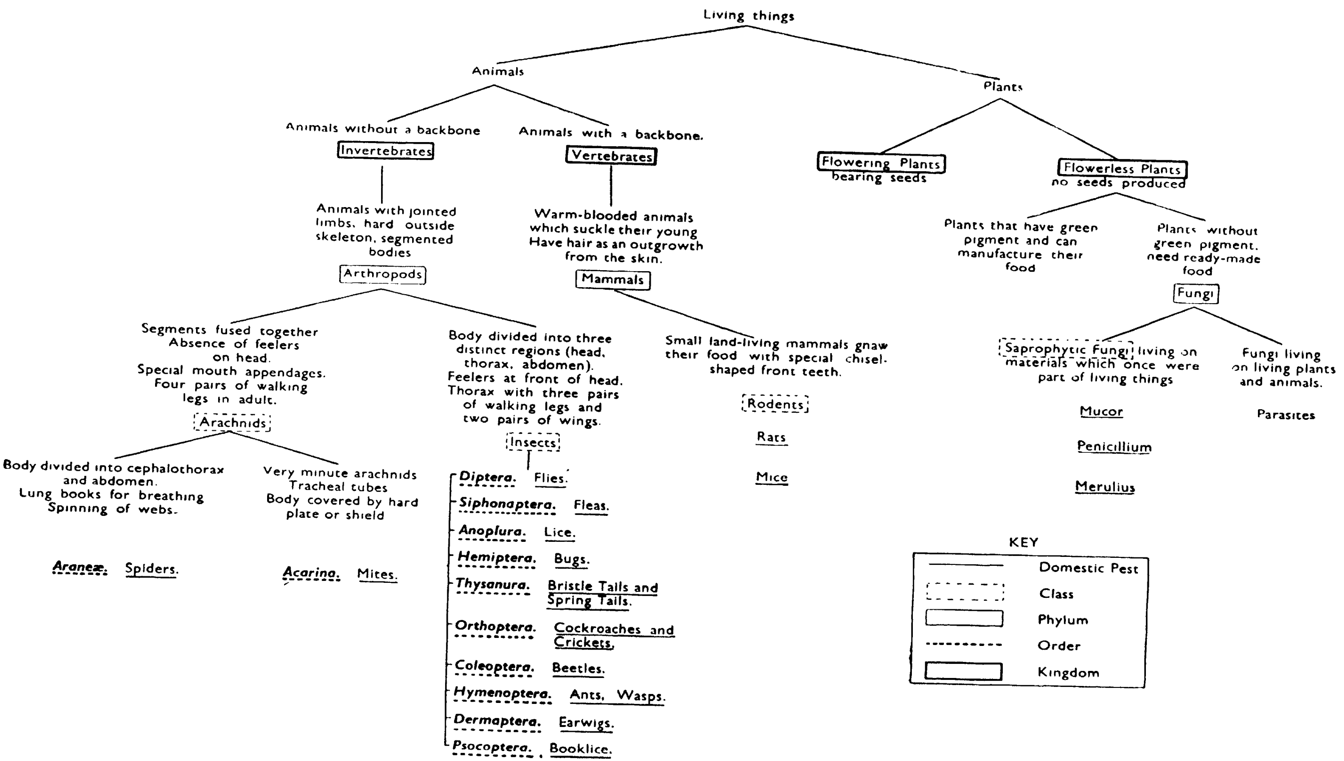
Living things
Animals
Plants
Animals without a backbone
Invertebrates
Animals with a backbone.
Vertebrates
Flowering Plants bearing seeds
Flowerless Plants no seeds produced
Animals with jointed limbs, hard outside skeleton, segmented bodies
Arthropods
Warm-blooded animals which suckle their young Have hair as an outgrowth from the skin.
Mammals
Plants that have green pigment and can manufacture their food
Plants without green pigment, need ready-made food
Fungi
Segments fused together Absence of feelers on head. Special mouth appendages. Four pairs of walking legs in adult.
Arachnids
Body divided into three distinct regions (head, thorax, abdomen). Feelers at front of head. Thorax with three pairs of walking legs and two pairs of wings.
Insects
Small land-living mammals gnaw their food with special chisel-shaped front teeth.
Rodents
Rats
Mice
Saprophytic Fungi living on materials which once were part of living things
Mucor
Penicillium
Merulius
Fungi living on living plants and animals.
Parasites
Body divided into cephalothorax and abdomen. Lung books for breathing Spinning of webs.
Araneæ. Spiders.
Very minute arachnids Tracheal tubes Body covered by hard plate or shield
Acarina. Mites.
Diptera. Flies.
Siphonaptera. Fleas.
Anoplura. Lice.
Hemiptera. Bugs.
Thysanura. Bristle Tails and Spring Tails.
Orthoptera. Cockroaches and Crickets.
Coleoptera. Beetles.
Hymenoptera. Ants, Wasps.
Dermaptera. Earwigs.
Psocoptera. Booklice.
KEY
Domestic Pest
Class
Phylum
Order
Kingdom

CHAPTER VI

THE MEANING OF CLASSIFICATION, WITH A CHART CLASSIFYING DOMESTIC PESTS

ALL living things are either plants or animals. Both these are arranged by the scientist into groups according to their structure and the way they develop. The Swedish naturalist Linnaeus was the first to attempt to classify animals and plants, and his method is to a very large extent still used to-day. There is a recognized way of classifying plants and animals, and scientists all over the world use the same name for living things showing similarities of structure and development. For instance, animals which have a hard outside skin, a body divided up into sections, and have many-jointed legs, are spoken of as jointed-footed animals, or Arthropods. Beetles, flies, crabs, spiders, shrimps, mites, all belong to this group. Since great variety is shown between members of a large group (phylum) of animals or plants, the scientist subdivides a big group into smaller ones and then again subdivides. Thus the Arthropods are subdivided into Insects (e.g. beetles and flies), Crustacea (e.g. shrimps and crabs), and Arachnida (e.g. spiders and mites). The further subdivisions are spoken of as orders, families, genera, and species, and each of these has a scientific name applicable all over the world whatever the language of the country may be. Every plant or animal, although having a name in the language of the country, has also a scientific name common to all countries. This name consists of two words, the name of the genus and name of the species. In England we speak of the housefly as distinct from the blow-fly, but these names would not be understood in another country. The scientific names of these flies, namely, *Musca domestica* and *Calliphora vomitaria*, would apply the world over, and so are often given as well as the English name in much of our literature.

CHAPTER VII

SPECIAL CHARACTERISTICS OF THE ANIMAL AND PLANT GROUPS, MEMBERS OF WHICH ARE DOMESTIC PESTS

INSECTS

THE greatest number and most formidable of the domestic pests are the insects. These have a jointed body, which is covered by a hard, tough skin, and numerous paired jointed legs called appendages which are modified for needs other than walking, for example, feeling and cutting. The majority have wings for flight. When fully grown, the body of an insect is usually divided into three distinct parts—a head, thorax, and abdomen.

The *head* is adapted for searching for and getting food. It usually has eyes, feelers, and a mouth surrounded by structures adapted in some way for getting food. Some types of insects have serrated-edged structures (mandibles) which tear food. These are found in the cockroach. Other types of insects have the mouth structures modified to form a sucking tube (proboscis), as is typical of the housefly. In other types, besides the sucking tube, there are modifications of structures to form piercing needles. The insects such as bug and louse, which suck man's blood, have these adaptations.

The *thorax* or middle part of the insect's body consists of three divisions (segments), and is that part of the body directly concerned with movement. A pair of walking legs usually grow from each division and are modified according to the habits of the various types of insects. Those which run, for example the cockroach, have the legs well developed, whilst a jumping insect like a flea has extraordinarily well-developed legs. The second and third segments usually have each a pair of wings in many adult insects, but these structures are adapted to suit the mode of life of the insect. For instance, the house-fly has the second pair of wings modified as balancers; the cockroach has the first pair serving as covers; adult lice have no wings; silver-fish have no wings at any period of their life; the clothes-moth has membranous scales covering the two pairs of wings.

The *abdomen*, sometimes called a tail and consisting of several segments, is concerned with reproduction, digestion of the food, and circulation of the blood.

There are two interesting phenomena peculiar to insects, namely their mode of breathing, and their power of casting or moulting their skin to enable growth to take place. The air, containing the essential oxygen, passes through small holes (spiracles) which are situated along the sides of the body. These holes lead into tubes which take the air all round the insect's body and out again through the holes. This system of entry and circulation round the body is one of the most vulnerable points, advantage of which may be taken in endeavouring to exterminate an insect. With regard to the second phenomenon of moulting, it is evident that since insects have such a tough inelastic skin their growth is accomplished only by the periodic casting or moulting of this unyielding covering. Growth having taken place, the new skin quickly becomes hard, and ultimately it is cast once more to allow of further growth. Moulting cannot take place after an insect's delicate wings are fully formed, for without the hard skin they would collapse. Thus it is only mature adult insects that have well-developed wings, and during the growing period, when moulting is taking place, the insect in most cases is very different from the flying adult. In the winged insects their growing childhood is spent crawling in search of food. At this stage it is usually totally unlike the mature adult, which often has a very short life spent mainly in searching for a breeding place.

With regard to breeding and development the insects differ considerably from most other animals; their life-history is usually much more complicated. All insects lay eggs, usually in a place where, upon hatching, the young form will have plenty of the food it likes at its disposal. The majority of insects on hatching from the egg have very few of the adult characteristics. They pass through three clearly defined stages before attaining the mature adult form, and each stage in the complex life-history is devoted to some special work. The first stage, called a larva, maggot, grub, or caterpillar, is a worm-like simple structure divided up into segments each having a pair of very small legs. The creature spends its time crawling about in search of food, eating, and increasing in size. It has structures round the mouth adapted for cutting or sucking its food, and it moults several times to enable growth to take place. Ultimately feeding ceases and then a moult takes place which reveals a totally different type of creature. This is the second stage in the life-history and the creature is called a pupa or chrysalis, and very often an outer covering is formed round it called a cocoon or puparium. This is typically a resting stage, for no eating, travelling, or moulting takes place, but tremendous internal changes are brought about. The larval structure within the very tough pupal skin completely breaks down to pulp, and reorganization takes place, so that sooner or later the skin cracks and the perfect mature adult insect emerges. This third or final stage is called the *imago*. It is a stage of active movement, mating, and laying of eggs to start a new generation, and in some insects, like the housefly, a little eating takes place at this stage. Insects passing through these three stages are said to undergo *complete metamorphosis* or *indirect development*. It is quite evident that in such complicated life-histories there may be some stages more favourable than others for successful attack on insect household pests. Typical common insect domestic pests undergoing complete metamorphosis are the housefly, clothes-moth, furniture beetle, and flea.

Other insects have no resting pupal stage during their development and have what is called a *direct life-history*. The egg hatches into something which is structurally fairly similar to the parent except for size and also absence of wings (if it be the young form of a winged insect). All that is necessary is periodic casting of the skin to enable growth and gradual appearance of wings. The first stage is spoken of as a *larva*, but after the first moult the young growing form is spoken of as a *nymph*. The number of moults varies in insects which develop thus, and at each moult a more mature form emerges, until at the last casting of the skin the perfect adult insect emerges. Each larval or nymphal stage is spoken of as an *instar.* This mode of development is *direct* or *incomplete metamorphosis* and is exemplified by the bug, which moults five times and has one larval and four nymphal stages. Other insect domestic and personal pests which develop in this way with no sudden changes in their life-history are silver-fish, lice, and cockroaches; those cockroaches which have wings in the final adult stage, develop them gradually at each moult.

Thus insects show great variety in modes of breeding and mode of life, and form an enormous group, members of which are found practically everywhere. They can make use of almost anything organic as food, and as eaters, the majority of them are a nuisance to man. Many of them have become domestic pests because of conditions created by man for rapid reproduction and adequate supplies of food.

ARACHNIDA

The group Arachnida includes a number of small Arthropods such as spiders, mites, and ticks, which although different in some respects, have certain common characteristics which link them together and distinguish them from all other animals. Since they have segmented bodies, jointed appendages, and a hard outside skin which is shed during the growing period, they are often confused with Insects. They differ from insects in having no feelers, four pairs of walking legs instead of three pairs, and the segments fused together. The mouth has two pairs of special appendages (the cheliceræ and pedipalps) which are adapted for seizing and holding food. These creatures move about by means of the four pairs of walking legs as there are never any wings. Development is direct, and the egg hatches out into a larva similar to the adult except that it has three pairs of walking legs; the nymphal stage, however, has four pairs like the adult.

Several Arachnida invade the home, some of them in order to get food, but some come in quite accidentally and with no definite object. Included in the latter is one of the little red spiders, really a mite, which strays into ground-floor rooms from foliage near the windows but does no harm; also the true spider enters the home but apart from the unsightly webs which it spins it does no harm. Many of the mites, however, are permanent inhabitants of the home and are harmful pests. Some of them live in our food, especially flour and cheese; others live in furniture; some are ectoparasites living on man's skin and are the cause of some skin diseases.

Spiders (Araneida) are distinct from mites in certain important respects such as size and mode of breathing. For instance, spiders have some special lung-books for breathing, can spin a web, and can easily be seen. On the other hand mites (Acarina) have air-tubes (tracheæ) like those of insects, for breathing, and are usually very difficult to see owing to their small size.

RODENTS

Rodents are a group of animals which, like man, are spoken of as mammals since they have hair, and suckle their young, which are born alive; also they have a chest cavity separated from an abdominal cavity by a muscular partition called a diaphragm. They are four-footed, quickly moving, fairly small mammals, and are widely distributed over the world, being more numerous than any other mammal. Several kinds of rodents live in this country, namely hares, rabbits, squirrels, guinea-pigs, rats, mice, voles, and most of them make use of man's possessions in either home, garden, or farm. Some of them, such as rabbits, are formidable agricultural pests, for they ruin growing crops; others, such as rats, are serious pests both to the farmer and housewife; they do serious damage both in and out of doors. Both rats and mice are a real menace to mankind for they have completely linked their fortunes with man and his possessions. Moreover, rats are known to carry disease to man.

Rodents are gnawing animals and can be recognized by their front teeth (incisors), which are adapted as chisels. This adaptation is brought about because the enamel of those teeth, whilst being exceptionally hard at the front, is fairly thin at the back of each tooth. The action of gnawing causes wear, especially of the thinnest part at the back of the tooth, which results in the characteristic sharp edge. There are usually only two incisors in the upper jaw, but if there are four, as in the rabbit, one grows behind another and so gives the appearance of two. There are two sharp-edged incisors in the lower jaw and their edges exactly meet the incisors of the upper jaw. So these teeth-edges wear away against each other and against the material through which they are gnawing, and a chisel-shaped edge in the teeth is maintained. Unlike human teeth, the incisors of the rodents continue to grow throughout their life to compensate for wear due to persistent gnawing. Thus the opposite teeth of both jaws are constantly touching one another.

Rodents in this country are really nocturnal creatures, although occasionally, if disturbed, they may be seen by day. They are very silent creatures and move extremely quickly on the four plantigrade feet. The majority of them collect food, such as garden and farm produce or the farmer's or housewife's stores, which they carry to their nest or burrow. Some, for instance rabbits, make elaborate warrens underground, whilst others, for example hares, nest and have stores of food and nursery on the surface of the ground in some herbage. Rats and mice make nests where they store food and nurse their young, but are constantly shifting their quarters and making new homes.

All rodents are very prolific, and for the majority the breeding season usually extends over as much as nine months of the year if the weather is mild. Several young are produced at a time, and these are immature and often blind, and are cared for by the female, who brings them food and protects them even against great odds. Usually several litters are produced in one season, and frequently the young themselves have begun breeding before the season is over.

FUNGI

Like animals, plants require food and oxygen to support life, and have the power of reproduction. Most familiar plants have green colouring matter (chlorophyll) in their make-up, especially in the leaves. This pigment enables them to use energy from the sunlight to manufacture their own food from the simple materials which they take in from the air and soil. The leaves are the places where this manufacturing process (photosynthesis) takes place. Those plants which have no leaves or chlorophyll are unable to manufacture their own food and have to depend on ready-made food. This they obtain either from living plants and animals or from materials which once were part of living things. These plants which do not possess the independence of green plants are called *fungi.* Those that live on living things are called *parasitic fungi*; the rest are *saprophytic fungi.* Some of the saprophytic fungi are formidable household pests.

All these saprophytic fungi are adapted for their special mode of life. They consist of two parts, namely a system of fine white tangled threads forming a network usually called the *mycelium*, and the *spores* which correspond with seeds in ordinary plants. These spores, like seeds, germinate under suitable conditions of moisture and warmth, producing another mycelium, and thus a new plant is formed. Growth and branching of the threads (hyphæ) of course depends on whether conditions of moisture, temperature, and supply of food continue to be favourable; if so, the hypha from the germinating spore grows and branches so frequently that a whole feltwork of tangled hyphæ is quickly formed. Since oxygen is required for respiration the threads only penetrate into the top layers of the materials on which the fungus grows.

The saprophytic fungi are the principal fungi which do harm in the home. Foods such as jam, lemons, cheese, potatoes, and in fact almost any food, left exposed to air in a damp warm place will frequently develop a greyish green cobweb-like furry coating which is a filamentous saprophytic fungus. Stale moist bread often becomes covered with a fluffy whitish blue feltwork dotted all over with structures like black-headed pins. This particular saprophytic fungus, mucor, is therefore often called the " pin mould." Other moulds cause green, black, brown, and yellow patches on the walls of our homes, and not only does the paint and wallpaper become discoloured but the latter peels off. The tangled network of the threads of the mycelium is living at the expense of oils, size, paste, and wood pulp. All walls have some of these necessary food materials for moulds to live on, but unless moisture is supplied germination of spores and growth of fungi is prevented. It is therefore only on suitably damp walls that such growths appear. Dry rot is caused by other fungal moulds living at the expense of the wood and causing it to become soft and spongy, with splits across the grain.

Periodically in all these moulds certain of the mycelium threads become erect and penetrate into the air and a little knob develops at the free end of each erect thread. It is these threads that the housewife sees on the walls of her room and on her foodstuffs. They indicate that her goods are being harmed, for of course she sees only very little of the actual plant. The little knobs are spore cases which contain countless minute colourless spores, which, when ripe, are shot out by the bursting of the case or sporangium. The spores are invisible to the naked eye and float about in the air. If a spore settles on some suitable food substance under favourable conditions of moisture and warmth the spore quickly germinates and a new mycelium is formed. In some fungi reproduction may occur in a different way, by means of which the fungus can withstand periods of drought and other unfavourable conditions. A special structure (zygospore) forms, which is extremely resistant and can remain in an inactive state for a very long time. When favourable conditions are eventually restored the fungus becomes active and makes itself obvious as a mould once more.

PART II

BRIEF DESCRIPTION OF EACH DOMESTIC PEST, INCLUDING A SIMPLE REMEDY FOR ITS ERADICATION, AND A LIST OF REFERENCES

CHAPTER VIII

THE BED-BUG (*CIMEX LECTULARIUS*)

What are bugs?

Bugs are insects which have mouth parts in the form of a long proboscis adapted for piercing and sucking. The bed-bug is wingless.

Kinds of bugs.

Certain bugs are formidable pests in the home and garden. Those in the home are suckers of human blood and are spoken of as bed-bugs. There are two kinds, one common in the tropics and the other (*Cimex lectularius*) common in temperate countries such as Great Britain.

Is the bug a serious pest?

The bed-bug is a common and troublesome pest and is one of the most objectionable pests which infest the home. It spends the whole of its time in the home, either sucking blood from members of the household or breeding in some crevice of furniture or wall. It lives and breeds wherever strict attention to cleanliness is not maintained, so that if a single female bug is brought into a home, perhaps in some furniture or trunk, it is possible for a home quickly to become infested. It frequently happens that in rows of houses a bug from a dirty home may travel into a clean home and attack members of the household. After a meal of human blood it will return to the dirty home where it can live and breed unmolested. The demolition and reconstruction of old insanitary houses of the working classes in recent years has brought the question of bug infestation into great prominence, for it has revealed not only the great number of homes which are bug-infested, but also how easily a new house can become infested.

What harm is done by the bug ?

Bugs are a menace to national health. By attacking man at night in their search for food, they cause much disturbed rest and are a source of much uneasiness. Persons react very differently to the bite of a bug. There is usually a little itching at the time of a bite which causes some inflammation, but this disappears fairly soon. Persons vary as to their sensitiveness to the bite, however, for some later develop swellings and places of irritation which continue for several days and may even cause disfigurement. A good counter-irritant for a bug bite is tincture of iodine; peroxide of

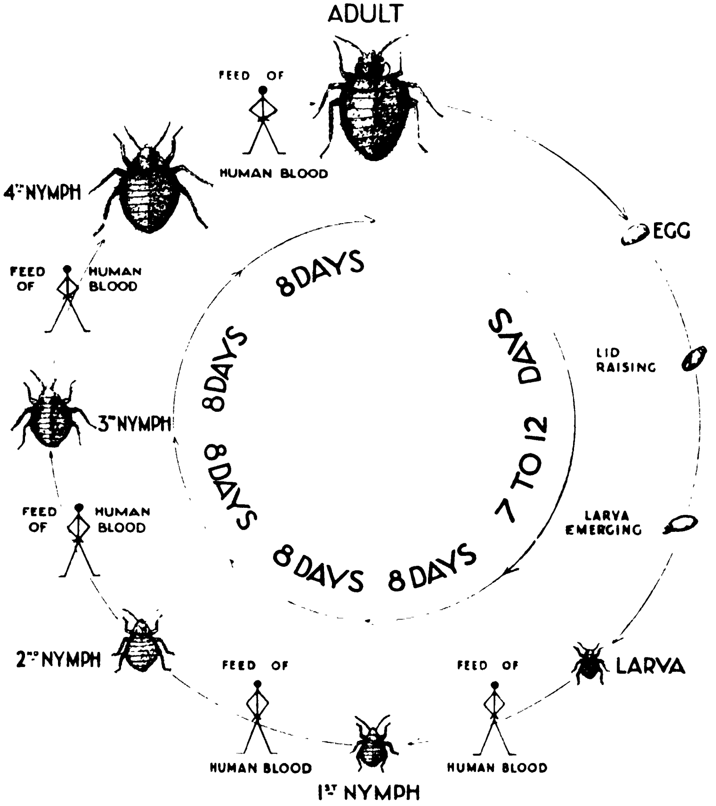

FIG. 1.—Life-cycle of Bed-Bug. (*Adapted from the Parkes Museum*)

hydrogen is also efficacious. Apart from the inflammation resulting from bug bites it is possible that these pests transmit disease to man, or at least contribute to ill-health.

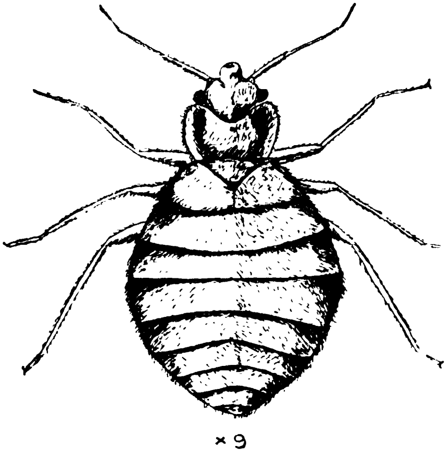

FIG. 2.—Bed-Bug, female, dorsal view. (After Patton.)

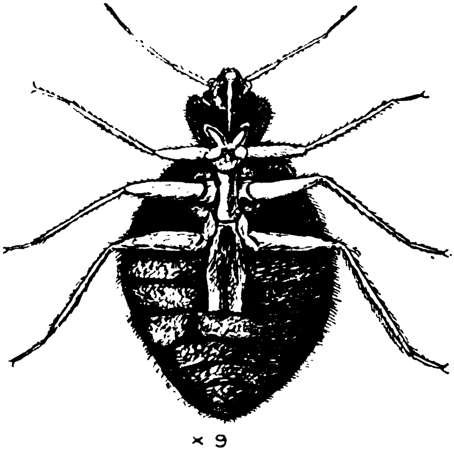

FIG. 3.—Bed-Bug, female, ventral view. (After Patton.)

Which part of its life is it a pest?

Blood is the only food of the bed-bug, and since it prefers human blood it is an active pest of man throughout the whole of its life. It is thought by some authorities that failing human blood the bug will resort to other blood. But its power of resistance to starvation and its periods between meals are great, and the knowledge on the subject of its imbibing other than human blood is scanty.

External appearance of the bed-bug.

The adult bug has an extremely flat, oval, bristly, body, about $\frac{3}{16}$ in. long and $\frac{1}{8}$ in. wide; it is thus difficult to see on account of its small size. It is brown in colour and on magnification is seen to have a body divided into segments which are particularly obvious in the thorax and abdomen. The short, broad, head is not distinct from the thorax by any kind of neck (figs. 2 and 3).

The blunt head region has a pair of eyes, a pair of small feelers, and some structures around the mouth adapted as an instrument for piercing and sucking. This specialized structure (fig. 4) when not in use, is folded back and tucked in a groove on the underside of the thorax.

The thorax has three pairs of walking legs growing from the under surface; these are well developed, since the creature relies entirely on them for movement. It can run quickly, and clings securely by the sharp claws which terminate each leg. On the upper surface of the thorax there is a pair of little wing pads. There are two stink glands on the underside of the thorax which give off an unpleasant smell, and the presence of a number of bugs in a house can often be detected by this smell.

The oval abdomen forms the largest part of the body, and the female bug has a more evenly rounded one than the male. Also, on the underside of the female, one of the segments has a cleft which is concerned with reproduction.

Habits of the bed-bug.

The bed-bug lives in cracks and crevices in the home, whether in the furniture or in the structure of the house. They hide beneath wallpaper and are known to travel from house to house through cracks in walls, behind wainscoting, and even along pipes in their search for food. Eggs are laid in these places and the young forms live with the older bugs and sally forth for food periodically. Bugs are nocturnal, and the food (human blood) is imbibed at night. It is for this reason that they attack members of a household at night, usually when in bed, and thus earn their name. The bug pierces any exposed human skin, and it is consequently the face and neck which are usually bitten. The bug gorges itself with so much blood that the replete creature looks different from the hungry one

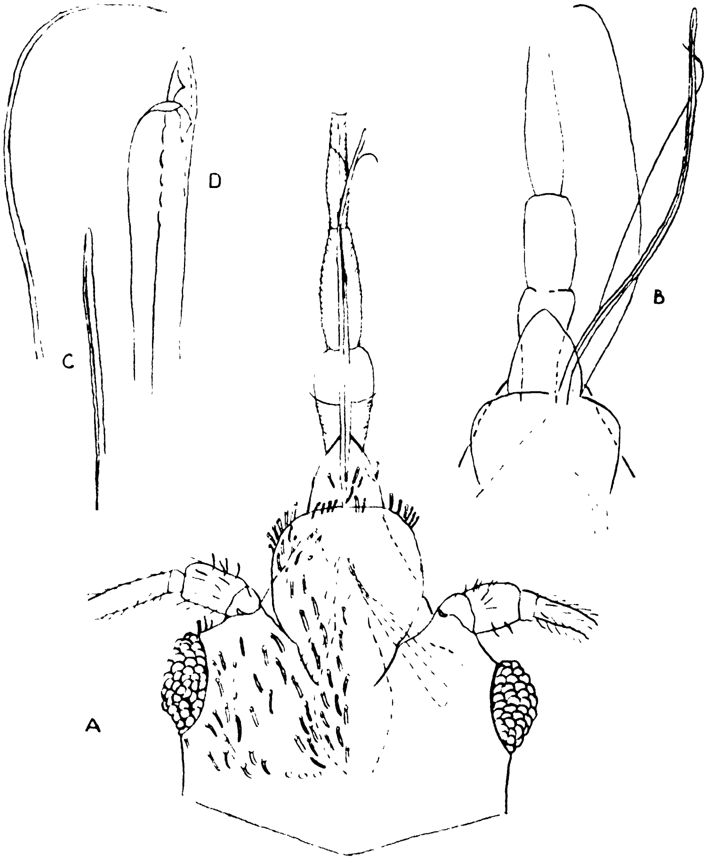

FIG. 4.—Head and mouth parts of Bed-Bug. Much enlarged. A. Head of female bug with proboscis extended. B. Proboscis and mouth parts shown enlarged. C. Mandibles enlarged. D. First maxilla enlarged. (After Patton.)

and is not so flattened. When replete, the bug withdraws its sucking tube, turns to regain its hiding-place, and usually defæcates before leaving, the excrement falling into the wound in the human skin. The mature bug does not feed daily, but often remains in its crevice, subsisting for several days, sometimes weeks, on one meal. No other food than blood is taken by bugs. They are more fertile when well fed and are considered by some authorities to be more vulnerable just after a meal.

The adult bug varies in length of life dependent on circumstances of food and temperature, and may live for many months; it is recorded that they can live up to four years, although eight months is estimated to be their average life. They are more active in warmth, and are consequently very evident in the warmer months of the year; especially is this noticeable in infested homes not centrally heated. More complete knowledge is very necessary, however, about the relationship of environmental conditions to the habits of bugs, especially as to the effects of food and temperature, the types of crevice favoured and why, and as to whether bugs return to the same crevice after a meal.

Life-history.

The female bed-bug lays eggs either singly or in groups in crevices; in warm weather they are laid daily. She probably produces up to 200 eggs in her lifetime, the majority of which are fertile, especially those laid after a meal. A cement-like substance exuded with the eggs fastens them in the crevice. Each egg is a yellowish-white elongate object $\frac{1}{20}$ in. long. It tapers to one end, which has a collar round a lid which lifts up when the young form emerges (fig. 1). Since metamorphosis is incomplete the larva which emerges from the egg is a colourless immature adult. The egg may hatch in a warm temperature in four to eight days, but if laid in late autumn it may lie unhatched until the warmth of spring.

The larva has a piercing, sucking apparatus and, like its parent, it searches for a human to get a meal of blood. In order to grow it must cast its skin, which it usually does in a week's time; the nymph which emerges resembles the adult more closely, as it has the beginning of wing pads. After feeding on blood it moults again in the course of about a week; the second nymph is slightly larger and even more like an adult. Again more blood is taken, another moult occurs, and the third nymph emerges with a darker skin. After another feed and moult a fourth nymph appears which normally moults at the end of a week, and the adult male or female emerges. The cast skins of these stages are left in the wall or furniture crevices which the colony of bugs are infesting. Under favourable conditions, that is, with a ready food supply and a suitable temperature, the egg becomes an adult and parent in six weeks, but usually circumstances lengthen the childhood period by a few more weeks and in wintertime by several months.

How to prevent this pest.

Prevention is the keynote of the bug problem. It is essential to prevent the entry of bugs into the home. First must be eliminated all potential homes or harbourages for the bugs, such as crevices made by constructional contrivances like skirtings and picture-rails, and greater attention should be given to window and floor construction and to the plumbing of houses. Secondly, more careful attention must be given to the cleaning of homes; superficial cleaning and polishing is useless, as it does not reach the places where bugs take refuge. Very careful scrutiny and cleaning should be given to secondhand furniture. The source of firewood should be ascertained, particularly in these days of slum clearance.

Simple remedies.

Since a female bug may enter any home either on clothing or other material (e.g. laundry baskets), it is essential to be able to recognize signs of its presence before it has time to settle in some crevice. It may be recognized by the objectionable odour from the stink-glands or from the irritation set up from a bite, or from a crushed individual on the clothing. Having recognized its presence a housewife can do much to check an infestation by thoroughly scrubbing and cleaning with hot soapy water and washing soda all likely articles and structures, especially the crevices. She should pay particular attention to the bedroom, for it is in a crevice here that the bug will endeavour to establish itself so that it has food conveniently close at hand at night-time. It is foolish to place too much reliance on the very numerous preparations on the market which claim to get rid of bugs. The efficacy of some of these is doubtful since the chemicals they contain must come in actual contact with the bug in order to destroy it. This is extremely difficult to achieve on account of the bug's power of concealment, but thorough dusting and scrubbing often destroys eggs, nymphs, and adults, effectively.

If the housewife wishes to be certain that she has eradicated the stray bug and any of its progeny she can resort to fumigation with sulphur. After clearing the room of all metal articles she should seal up all windows, doors, and chimney, and then burn some sulphur, about 3 lb. in a room 12 ft. square. Care should be taken before setting fire to the sulphur and leaving the room to the burning sulphur, to protect everything from contact with the burning sulphur to prevent fire. The room should be exposed to the sulphur fumes for at least twelve hours.

What to do in a serious infestation.

If the infestation is acute it is not a matter for the housewife but for the local authority. Many occupants of bug-infested homes are willing to report the matter to the public health authority, but it is to be regretted that even to-day public opinion (neighbours, etc.) sometimes deters the reporting of this pest. The usual procedure of the local authority is to send experienced men to fumigate the home. Many preparations and precautions have to be taken by these experts, as the most efficacious fumigants are harmful to man. Hydrogen cyanide and orthodichlorbenzene are the chemicals which are known to produce most certain results, and references are made in the I.C.I., Ministry of Health, and British Museum publications (*see* references), concerning these chemicals and their use in destroying bugs.

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KEY TO CONTENTS

A = Description of pest.
B = Description of life-history.
C = Effect of pest on man.
D - Methods of control.
E Good illustrations.
* - If cost is under 1s. 6d.

CHAPTER IX

FLEAS

What are fleas?

Fleas are insects which in the adult stage depend upon the blood of mammals or birds for food. This they obtain by piercing the skin of their host. They have bodies which are flattened from side to side, and so they can easily pass between hairs or feathers. They have three pairs of very well developed legs but no wings. The larvæ of the fleas are totally unlike their parents for they have a worm-like body with no legs, do not live on a host nor feed on blood.

Kinds of fleas.

There are about 500 different kinds of fleas living on a great variety of animals, and of these four kinds are found infesting the home. They are the human flea (*Pulex irritans*), which usually lives only on human blood; the cat flea (*Ctenocephalus felis*), which lives usually on cats, but readily attacks dogs and other animals including man, and is therefore very common in many homes; the dog flea (*Ctenocephalus canis*), which lives on the dog but frequently attacks man; and the fowl flea (*Ceratophyllus gallinæ*), which is often found on poultry and readily sucks man's blood. Occasionally the plague flea (*Xenopsylla cheopis*) attacks man, but only if the home is overrun by the black rat which is the regular host of this flea. In Great Britain the black rat, however, is not so prevalent as the brown rat. Then, too, another rat flea (*Ceratophyllus fasciatus*), found on mice and rats, occasionally finds its way to man.

Is the flea a serious pest?

The fleas which get into our homes either on other animals or on ourselves are serious pests because as adults they live very intimately with us. Since they pierce our skin in order to get their meal of blood they make wounds, which are liable to receive any dirt-conveying disease germs and any excreta passing from the body of the flea. It is known that some rat fleas carry disease germs causing plague and, moreover, that these germs multiply in the flea's stomach forming a jelly which blocks the food tube. These diseased fleas may accidentally move on to man and the hungry flea pierces his skin. As it cannot suck up the blood easily because of its blocked

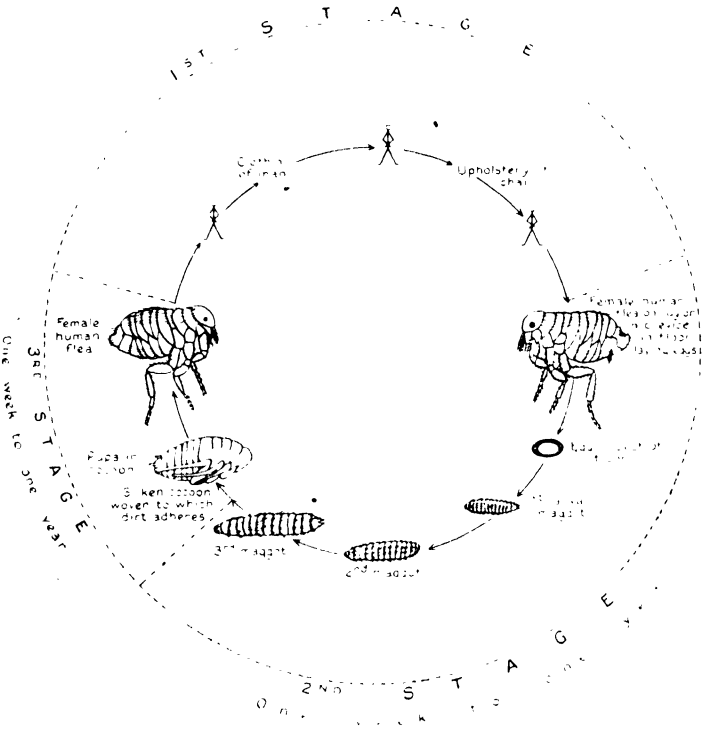

FIG. 5.—Diagram of life-cycle of the Human Flea. Not to scale.

1*st Stage* (adult period).—A time of great activity when the adult flea alternately leaps on to an individual to get a meal of human blood and rests between whiles on things with which man is in close contact.

2*nd Stage* (growing period).—A time of development and growth. The egg hatches out into a larva (maggot) which wriggles about in dirt of floors or rugs and eats organic debris. Moulting occurs twice.

3*rd Stage* (resting period).—The third maggot searches for a quiet crevice and makes a cocoon. The immature flea (pupa) rests inside.

tube, it regurgitates the jelly full of the disease germs into the wound in man's skin. Besides acting as disease-carriers, the movement of fleas on the body is a source of constant irritation to the host.

What harm is done.

It has been proved that bubonic plague is carried from rat to man and back to the rat by fleas. It is possible that other disease-germs are carried in a similar fashion to man from other hosts by other fleas. There is no doubt also that the irritation caused by flea-bites and the movement of the flea on the human body causes much disturbed rest. The irritation often results in scratching and tearing of the skin, leaving it exposed to infection. A flea-bite can be recognized by a central red spot where the skin was pierced, surrounded by a ring of inflammation. Persons vary very much as to their reaction to the bite of the flea and different kinds of fleas bite man with varying intensity.

During which part of its life is the flea a pest?

The flea is an ectoparasite only during its adult life, and it is then that it is a pest. Although the eggs, larvæ, and pupæ, spend their time in the home they do no harm either to man or to his possessions.

What does a flea look like?

The compressed body of the flea with the well-developed bristles and spines growing from the tough skin make for perfect adaptation to life amongst closely packed hairs. The projecting bristles, which are almost parallel with the body, prevent the flea from slipping backwards, and the claws at the ends of the three pairs of well-developed legs help the insect to cling to the hairs effectively. The complete absence of wings on the thorax is again an adaptation for movement between hairs, as wings would impede progress. The legs are extremely muscular and long, enabling the flea to jump relatively enormous distances (fig. 6).

The pale brown body of the female human flea is about $\frac{1}{12}$ in. long, but the male is smaller (fig. 7). The cat flea and the dog flea (fig. 8) of both sexes are smaller than the human flea. The latter has a pair of very small feelers, which are usually accommodated in special grooves in the head when not in use. The mouth parts which hang round the mouth are modified to form both a piercing and sucking apparatus. An elongated upper lip with serrated edges, together with two long stiff mandibles, form not only a piercer but, when interlocked, the tube through which the blood passes. Saliva pours down this tube into the wound made by the piercer. Some fleas, but not all, have eyes; and some have special comb-like structures in association with the head. On magnification *P. irritans*, the human flea, is seen to have eyes but no comb-like structures.

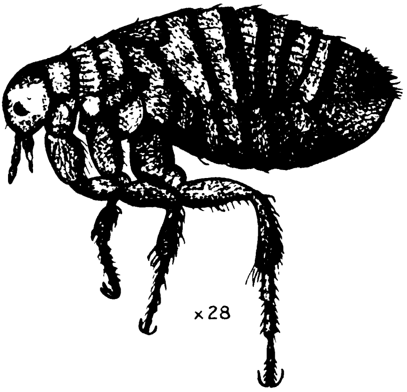

Fig. 6.—Human Flea, female.

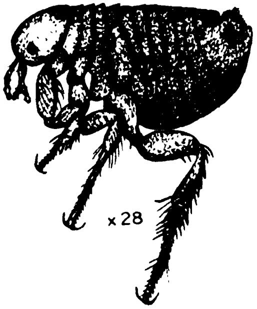

Fig. 7.—Human Flea, male.

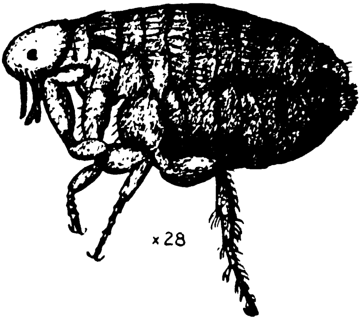

Fig. 8.—Dog flea, female.

What are the habits of the flea?

Each variety of flea prefers blood from one particular kind of animal, and so we speak of cat fleas, dog fleas, and human fleas. If, for some reason, the special host is not available, then the flea will become an ecto-parasite of another animal. For example, *X. cheopis* normally feeds on the blood of rats, but readily feeds on human blood. Because of this facility of making use of different kinds of blood and thus frequenting different types of host, fleas are carriers of disease from one type of animal to another, as is the case in bubonic plague. *C. gallinæ*, the hen flea, usually lives on hens but can suck man's blood, and can be just as annoying to man as the human flea is when on his body.

Some fleas spend the whole of their adult life on a host, but the human flea only jumps on to man when in need of a meal. Fleas can live for a considerable time without food, and experiments have shown that a flea never having had blood since it pupated can live 125 days, but that one allowed blood lived 513 days. Observations show that a damp empty house can harbour fleas for several months, which will then swarm on to the first visitor to the house and feed on him voraciously. The different species vary as to the length of time which elapses between feeds. Temperature affects the feeding habits considerably. In warm weather the fleas need more food since digestion goes on very much more quickly; in fact, all activities are speeded up by warmth.

Fleas tend to shun daylight and bury themselves in clothing to avoid capture. They are most elusive creatures and very easily sham death. By means of their powerful legs they can leap tremendous distances, the human flea, for example, having been observed to jump 13 in. horizontally and 18 in. vertically. The female human flea usually lays her eggs among rugs, carpets, dirty crevices in floors, or wherever there is an accumulation of dust. The cat, dog, and rat fleas may lay their eggs whilst on the host, but the eggs usually fall off.

Life-history of the flea.

The flea's eggs hatch into maggot-like creatures totally unlike the adult in both structure and habits. During development three definite stages are passed through, and a complete metamorphosis takes place after a long resting period before the final jumping flea appears. The female lays a few hundred white waxy oval eggs $\frac{1}{40}$ in. long, which can be plainly seen on a dark background. After a few days, depending on conditions of temperature and humidity, the eggs hatch into small white, bristly, segmented, maggots, which wriggle about in the dirt and dust, eating it. In particular, this larval maggot searches for and eats any regurgitated blood which has been deposited by adult fleas. The head of the maggot is rather brown in colour and the mouth has a pair of horny jaws. Two little pointed processes project from the last larval abdominal segment (fig. 9).

The maggot is extremely active and normally moves by the aid of its bristles, but if disturbed it wriggles the whole of its body in order to bury itself quickly in the dirt in which it is living. After a time this maggot moults and a slightly larger one emerges which grows, and in turn moults, producing a third and larger maggot. Before each moult the maggot stretches out lengthwise, but during growth it is usually in a coiled position. The third maggot grows and then wriggles to a place where it will be undisturbed and can lie quiescent. It may take from just over a week to as long as seven months to reach this resting stage. The maggot then spins a fine white silky cocoon to the threads of which adhere dirt particles from the surroundings, making the cocoon quite inconspicuous. The maggot inside completely reorganizes itself and is now called a pupa (fig. 10). The pupa stays in its resting condition for a varying length of time, from a week to nearly a year, dependent on temperature, vibrations, humidity, etc., but sooner or later the cocoon splits and the adult flea emerges. It can spend a considerable time before it requires food but

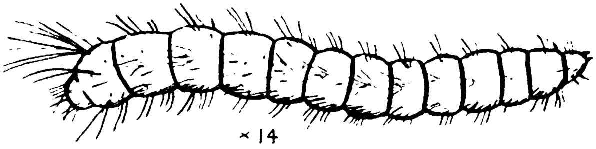

FIG. 9.—Larva of Human Flea.

the female must have a meal of her particular host's blood before she can lay fertile eggs.

Vibration seems to play an important part in the final emerging of the adult flea from the cocoon. This is especially true if the quiescent period has been prolonged, as in an empty house. A person entering such a house and causing vibration of the floors and walls may bring about the sudden emergence of hordes of fleas from their cocoons. These new adult fleas, together with the older adults which may have subsisted without food whilst the house was unoccupied, all attack and feed voraciously on the person entering the house. Such cases are well known to occur.

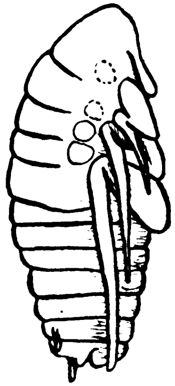

FIG. 10.—Pupa of Flea, much enlarged. (After Esdaile.)

How to prevent this pest.

Cleanliness of house, person, and pets, is really the best way to prevent fleas. It is readily understood, however, that a flea may easily enter a home accidentally either on a person, a pet, or even be blown in (e.g. during the shaking of a neighbour's rugs), even though the home is clean. Steps must therefore be taken to prevent an infestation. This can be done by limiting the food supply of larvæ and adults, limiting breeding, and preventing the entry of any flea-carriers into the home.

The food supply of the larva can be limited by regular cleaning of the home. The careful removal of dust and dirt from crevices means not only removal of food supplies of the larva but also destruction of eggs or cocoons lying in the dust. Pets such as dogs and cats, if flea-infested, must be kept entirely out of the house until they have been adequately treated with some insecticide. Regular washing of dogs in water containing carbolic helps them to repel fleas. Though it is difficult to wash cats they must be regularly combed, and pyrethrum powder or naphthalene should be rubbed into the fur so that they will repel fleas. Similarly, a repellent such as naphthalene or eucalyptus oil should be used on a person's clothing if visiting places suspected of being flea-ridden. Rats and mice should be entirely excluded from a home because, apart from the damage they do, they themselves are flea-carriers. Hen-houses, especially if near the house, should be kept clean and regularly limed out. A repellent such as alum or creosote added to the whitewash repels fleas from the hen-house and so from the fowls.

Simple remedies.

If the presence of fleas is suspected, then the host must be treated with an insecticide, and the house thoroughly cleaned, again using an insecticide. The person harbouring fleas should bath in water to which some carbolic has been added; the washable clothing must be put immediately to soak in water containing carbolic. Other clothing can be taken out of doors, naphthalene flakes scattered on it, and after leaving for some time, the clothing must be well brushed and left to air. A more effective way to penetrate clothing is to rub in a solution of naphthalene in benzene. This is a highly inflammable liquid and must be used with the greatest care, out of doors, and never where there is any flame or fire. Dogs should be washed in carbolic water and carbolic soap should be used.

Floors and woodwork in the house should be washed with water containing carbolic and any cracks and holes must be impregnated with naphthalene before being sealed up.

What to do in a serious infestation.

Naphthalene flakes scattered over a floor and the room left closed for a day will destroy many of the adult fleas, but to destroy the larvæ and cocoons more drastic fumigation must follow. After removing all metal fittings and hermetically sealing the room (including the chimney), sulphur should be burnt, using about 3 lb. in a room 12 ft. square. Adequate precautions against fire should be taken. After twenty-four hours the room should be opened and the floor and woodwork should be washed with water to which a paraffin-soap emulsion has been added. A suitable emulsion can be made by dissolving 3 parts of soft soap in 15 parts of hot water and stirring in very gradually 70 parts of paraffin oil. For use in washing take one part of this white creamy emulsion to 10 parts of water. By making its way into cracks, etc., this emulsion will destroy all flea-eggs and cocoons. Rugs and carpets must be thickly sprinkled with powdered naphthalene, put out of doors, and later well beaten and brushed before being put on to the cleanly washed floors.

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CHAPTER X

LICE

What are lice?

Lice are wingless insects with well-developed legs (fig. 12) each terminating in a sharp claw which helps them to cling to hair or clothing. They have flat bodies and a tough skin. The mouth parts, which are adapted for piercing and sucking, can be withdrawn into the head.

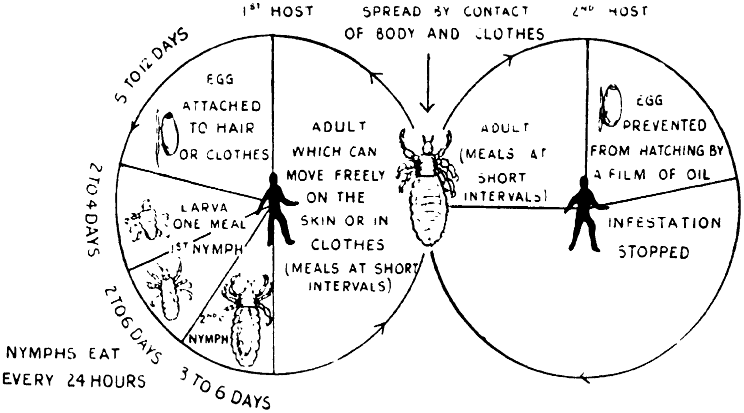
1st HOST
SPREAD BY CONTACT OF BODY AND CLOTHES
2nd HOST
5 TO 12 DAYS
EGG ATTACHED TO HAIR OR CLOTHES
ADULT WHICH CAN MOVE FREELY ON THE SKIN OR IN CLOTHES (MEALS AT SHORT INTERVALS)
ADULT (MEALS AT SHORT INTERVALS)
EGG PREVENTED FROM HATCHING BY A FILM OF OIL
INFESTATION STOPPED
2 TO 4 DAYS
LARVA ONE MEAL
1ST NYMPH
2 TO 6 DAYS
2ND NYMPH
NYMPHS EAT EVERY 24 HOURS
3 TO 6 DAYS

FIG. 11.—Life-cycle of Body-Louse of Man. (*Adapted from the Parkes Museum.*)

Kinds of lice.

Many lice depend on blood for food, and those which live on human blood are of three varieties: the body-louse (*Pediculus humanus corporis*) (fig. 13), the head-louse (*Pediculus humanus capitis*) (fig. 14), and the pubic-louse (*Phthirus pubis*) (fig. 15). As their names imply, the body-louse lives on the human body and clothing, the head-louse, which is very similar in appearance and habits, lives in the region of the head, and the pubic-louse, or crab-louse, lives in the region of the pubic hair, and is not such a common pest as the other two.

Is the body-louse a serious pest?

The louse spends all its life crawling about on some member of the household or on clothing. It is spoken of as a parasite, and the person on whom it lives is called the host. Since it lives on the outside of the host it is termed an ectoparasite. The louse pierces the skin of its host to get a meal of blood, and lays its eggs on the hair or clothes. Lack of personal hygiene, particularly regular washing of the body, hair, and clothes, gives opportunity for even a single female louse to lay her eggs unmolested, and very soon such a person becomes thoroughly lousy. The lice do not live on the dirt but on the

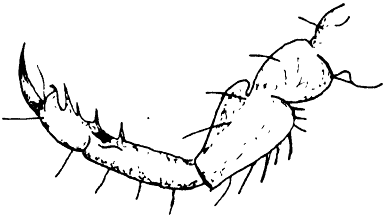

FIG. 12.—Hind leg of Body-Louse, much enlarged. (After Patton.)

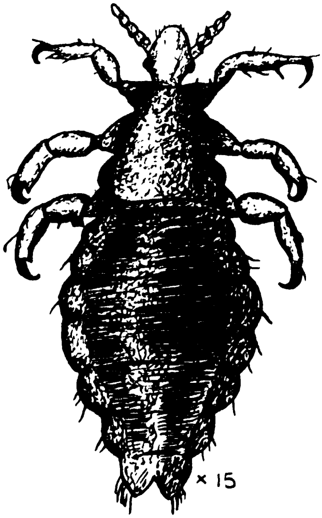

FIG. 13.—Female Body-Louse. (After Patton.)

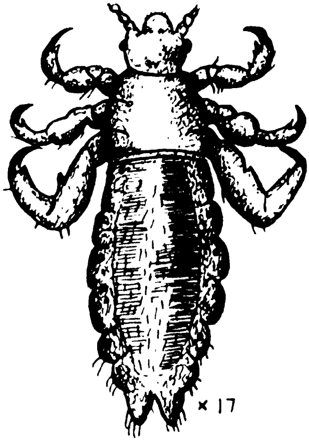

FIG. 14.—Female Head-Louse. (After Patton.)

blood of their host. Such a person passes on lice to others, often to clean persons, in any momentary contact of body or clothing. But the clean person does not suffer for long the irritation caused by the crawling and skin-piercing habits of these lice, for their cleanly habits automatically get rid of the pest before they become infested.

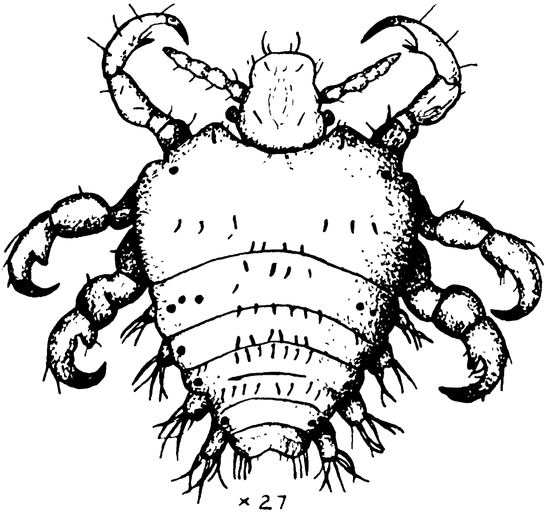

FIG. 15.—Female Pubic-Louse. (After Patton.)

What harm is done by lice?

Pediculus humanus is known to transmit at least three formidable diseases, viz. trench fever, relapsing fever, and typhus. The organisms causing these diseases are introduced either into the wounds the lice make in the skin, or into other abrasions of the skin. Moreover, the constant irritation caused by the crawling about and piercing of the skin results in scratching, which is thought to be the forerunner of certain skin diseases. Each bite of a louse causes a tiny puncture of the skin which becomes full of clotted blood and is surrounded by an inflamed patch lasting a week or so. A very lousy person loses sleep and has constant irritation due to the persistent activities of the lice. Habitual lousiness, however, seems to bring about a state of insensitiveness to these activities.

During which part of its life is it a pest?

The louse is a pest from the moment the egg hatches, when the larval louse immediately pierces the host's skin and sucks up some blood. It feeds regularly in this way throughout its life, which may be as long as six or seven weeks. The adult female lays eggs regularly on whatever host it happens to find itself.

What does the louse look like?

Both kinds of *Pediculus humanus* (*caporis*' and *capitis*) are somewhat similar in appearance (figs. 13 and 14). On magnification the head, thorax, and abdomen can easily be seen, and the whole outside segmented skin is extremely leathery, with only few bristles; the skin of the head-louse is more horny than that of the body-louse. Both kinds of *Pediculus humanus* have an oval body rather narrower in front than behind.

The female body-louse is about $\frac{1}{6}$ in. long and the male $\frac{1}{8}$ in. long. The head-louse is smaller, for the female is $\frac{1}{8}$ in. long and the male $\frac{1}{10}$ in. The head of each has very specialized and delicate mouth parts in the form of a stabbing apparatus which is enclosed in a special sac in the head. Part of the head is tucked under the thorax. The three segments of the thorax are distinct dorsally, and each has a pair of well-developed walking legs terminating in claws (fig. 12). There is no vestige of any wings. The abdomen, which is very distinctly segmented, is elongated and very much flattened; the spiracles (entrances to the breathing tubes) are situated here. The female louse has a slightly wider abdomen than the male and has also two special processes concerned with reproduction. In contrast, the crab-louse is a much more rounded creature with a compressed thorax and abdomen (fig. 15).

What are the habits of the louse?

The body-louse lives principally in the clothing next to the skin and can move about extremely quickly. It tends to move to outer garments to lay its eggs. Body-lice are usually more numerous in winter than in summer in this country because more warm underclothing is worn. There is also a tendency,

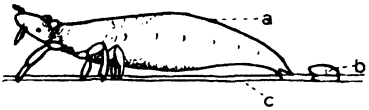

Fig. 16.—Human Body-Louse laying egg on hair. (*a*) louse; (*b*) egg; (*c*) hair. Much enlarged. (After Esdaile, after Nuttall.)

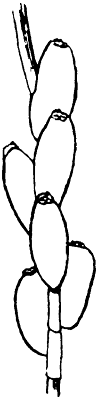

Fig. 17.—Eggs of the Head-Louse attached to a hair. Much enlarged. (After Esdaile, after Patton and Cragg.)

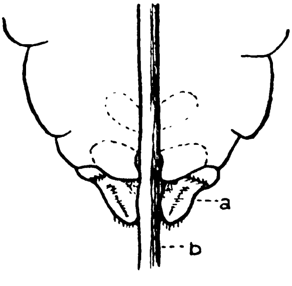

Fig. 18.—Lower abdomen of Human Body-Louse showing (*a*) gonopods, clasping (*b*) hair on to which the egg will be fastened. Much enlarged. (After Esdaile, after Nuttall.)

due to various circumstances, to wear underclothing in winter for longer periods without washing. It is said that temperature and moisture of the clothing affect the louse, which is usually more active when the host's body is more warmly clothed; in fact, they move to outer garments when the temperature of the skin gets fairly high, and so are easily able to transfer to a new host. If a single male louse passes on to a new host only slight irritation will occur during the creature's short life (probably not longer than thirty days), but a fertile female will lay eggs which, if left to develop, will hatch and cause lousiness on the new host unless removed. The head-louse is normally confined to the hairs of the head and it usually lays its eggs or nits at the back of the head close to the scalp. These head-lice can pass from host to host by contact or by means of head-gear. The pubic-louse is only spread from host to host by actual contact.

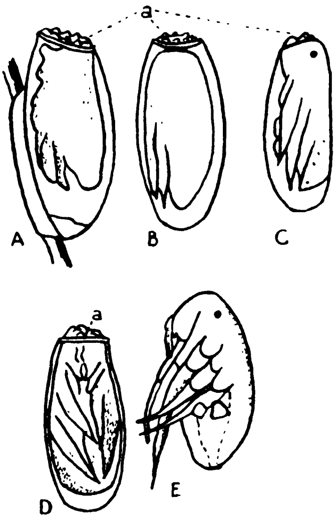

FIG. 19.—Stages in development of larva in egg case of Human Body-Louse. Much enlarged.

Stages A, B, C, D, show eggs of body louse with larva at different stages of development with lid (*a*) of each egg securely enclosing the larva.

Stage E shows larva immediately after emergence. (After Esdaile, after Nuttall.)

The life-history of the louse.

The female body-louse (fig. 16) lays up to 12 eggs a day, each about $\frac{1}{25}$ in. long, and in her adult life produces about 300 eggs. These are firmly fixed by means of a cement substance to hairs by the head-louse (fig. 17), and to clothing and body hair by the body-louse (fig. 18). Each egg has a lid which is lifted up by the newly hatching larva in from four to fourteen days, the time depending on the temperature (figs. 19 and 20). Incomplete metamorphosis is characteristic of lice, so that the young larva is really a miniature adult which feeds immediately on hatching. It moults three times before it reaches the adult state, the second nymph being naturally more like the parent than the first nymph (fig. 21). Usually each nymph feeds once daily and often several times before moulting.

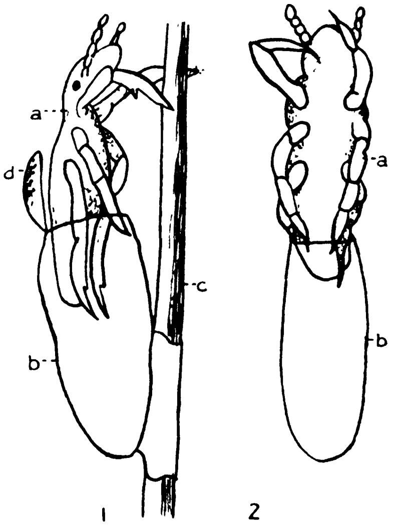

Fig. 20.—Larvæ of Human Body-Louse. Much enlarged.

1. Larva (*a*) moving out of egg case (*b*) and clasping hair (*c*) with its front legs. (*d*) Lid of egg case.

2. Under surface of larva (*a*) as it finally emerges from egg case (*b*). (After Esdaile, after Nuttall.)

How to prevent the pest.

It is important for everyone to know of the danger, the habits, and the life-history of lice, and to realize how easily they pass from person to person; for ignorance helps in allowing this pest to invade a household. Careful attention to cleanliness of person and clothing is the surest way of preventing an infestation.

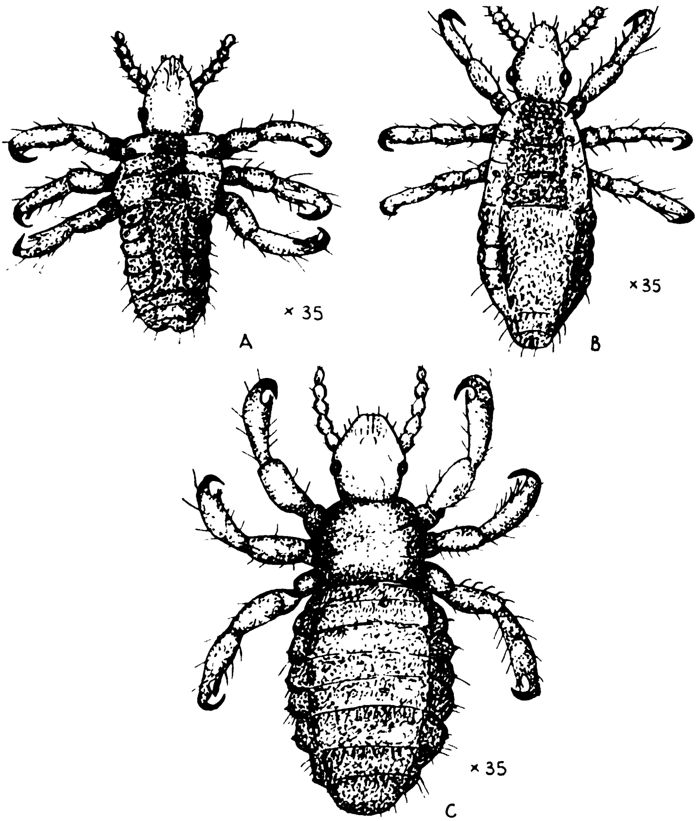

FIG. 21.—Stages in early life of Human Body-Louse.
A. Larva. B. First nymph. C. Second nymph. (After Patton.)

Simple remedies.

In the case of head-lice, if the infestation is not severe, it is sometimes enough to comb the hair well with a fine comb damped with vinegar or paraffin. There are numerous insecticides which are said to cure an infestation of the head-louse, but many are not much good. A cheap and safe means of getting rid of head-lice is to rub a mixture of equal parts of paraffin and vinegar well into the hair, especially at the roots. Wrap the wet head in a towel and leave for half an hour. Then wash several times in warm soapy water, dry, and comb the hair well. With severe infestations this treatment should be repeated the next day.

Getting rid of body-lice is a more difficult proposition. The louse and its eggs have very great resisting power against many chemicals either by contact or in the vapour form. Moreover, although many chemicals may be suitable insecticides to destroy the louse, they cannot be used since they would attack the delicate human skin or spoil the clothing. If body-lice are suspected it is possible to destroy them by rubbing the mixture of paraffin and vinegar well into the skin all over the body, and especially where there is growth of hair. This should be followed by a bath in warm soapy water and a change into clean clothing. The clothing taken off should have been carefully dropped on to paper and then put to soak for some time in water to which carbolic or lysol has been added; the paper must be burnt immediately. If the infestation is not serious, or is merely suspected, the clothing can be ironed with a hot iron, especially at the seams.

What to do in cases of serious infestation.

When a person and clothing are thoroughly lousy more drastic treatment is required than it is possible to give satisfactorily at home. It is then essential to resort to the certain measures of lice destruction by heat. Dry heat is considered to be more suitable than steam heat in the treatment of lousy clothing. In certain cities, for example Liverpool, the Public Health Department deals with serious cases of louse-ridden children. Whilst their bodies are being treated and bathed, their clothing is disinfested by an electrically heated disinfestor.

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CHAPTER XI

FLIES

Flies as Pests in the Home

Flies are insects which have only one pair of wings used in flying, the second pair having been modified as balancing structures. Flies invade our homes either accidentally or for a definite purpose such as laying eggs, getting food, or hibernating. Those that come in accidentally through open windows are not necessarily harmful, but tend to be a nuisance if they enter in swarms like the daddy-long-legs sometimes does, or leave excreta on the electric light bulbs as do some flies, or occasionally bite the householder as is sometimes the case with a stray stable-fly. Of the flies that come in for a definite purpose those that come in to hibernate and lurk in warm dark corners of the house during the winter months are not harmful pests, but the presence of these comatose flies in hidden corners suggests that the housewife does not clean the house thoroughly. It is the flies that come into the house for breeding or for food which constitute the most formidable pests, because any of these flies may have recently left some source of contamination. Consequently, not only is their presence annoying, but they may carry disease-germs to our food, and so are extremely dangerous to health. Knowledge of their feeding and breeding habits is essential if these flies are to be successfully excluded from the home.

Flies belong to that group of insects called Diptera, and although a few produce their young alive the majority, including those that are pests in the home, lay eggs. These eggs hatch out into segmented wormlike creatures with no legs, and are called maggots or larvæ. A series of moults and a resting stage usually follows before the adult fly emerges. In those flies which are pests in the home there are two moults during the growing larval period, and when the third larva (maggot) is fully grown it pupates in a special way. The larva contracts and the skin forms a brown case called a puparium within which is the reorganized larva, now called a pupa, in a new delicate skin. The breathing tubes of the pupa penetrate not only the pupal skin but also the puparium. Growth only takes place in the larval stages, and when the resting stage is entered on no more growth occurs. The pupa ultimately gives rise to the adult imago when conditions are suitable for the fly to become an active flying creature ready to search for a breeding place. Thus flies undergo a complete metamorphosis during their development from the egg and so are said to develop indirectly.

With regard to the carrying of disease the principal offender is the house-fly (*Musca domestica*), but the lesser house-fly (*Fannia canicularis*), and the blow-fly or blue-bottle (*Calliphora erythrocephala*) are also suspect. In fact all flies are unwelcome guests in the home, and although many of them are not thought to do serious damage they should be exterminated relentlessly to make for safety from disease. It is not possible for the busy housewife to recognize and attack only the dangerous house-flies and blue-bottles. It is far better for her to endeavour to prevent all flies from entering her home and particularly from having access to food, cooking utensils, and household refuse.

THE HOUSE-FLY (*Musca domestica*)

What does the house-fly look like?

The house-fly is a greyish-black insect about ¼ in. long and having two transparent wings with a span of ½ in.; each wing has the fourth vein turned abruptly forwards near the wing margin (fig. 23). The tough skin is covered with projecting bristle-like hairs and tiny scales which produce distinctive markings, forming in particular the four black stripes on the back of the thorax and the silvery appearance of the head. The head, thorax, and abdomen, are easily distinguishable: the head with its feelers and pair of large compound eyes; the thorax with its three pairs of walking legs and delicate wings which fold, slightly overlapping, over the back of the abdomen when the fly is at rest; the abdomen with its greyish spotted appearance.

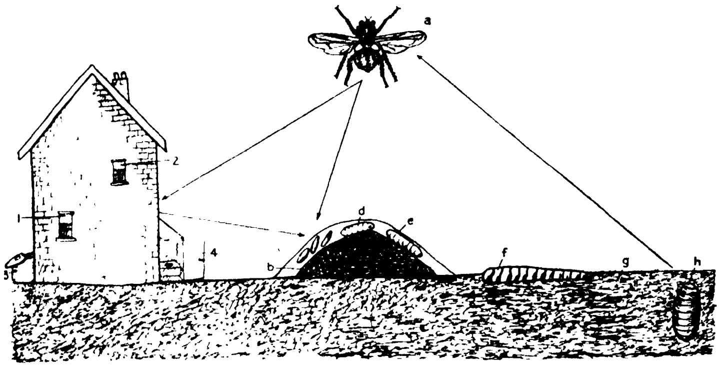

FIG. 22.—Diagram illustrating the life-cycle of the House-Fly (not to scale). (*a*) Adult fly ; (*b*) manure heap with (*c*) eggs ; (*d*) 1st larva ; (*e*) 2nd larva near surface of heap ; (*f*) 3rd larva migrating in upper surface of soil (*g*) to drier spot ; (*h*) puparium with pupa resting inside ; house with (1) open larder window ; (2) open bedroom window ; (3) uncovered dustbin ; (4) unprotected dry lavatory.

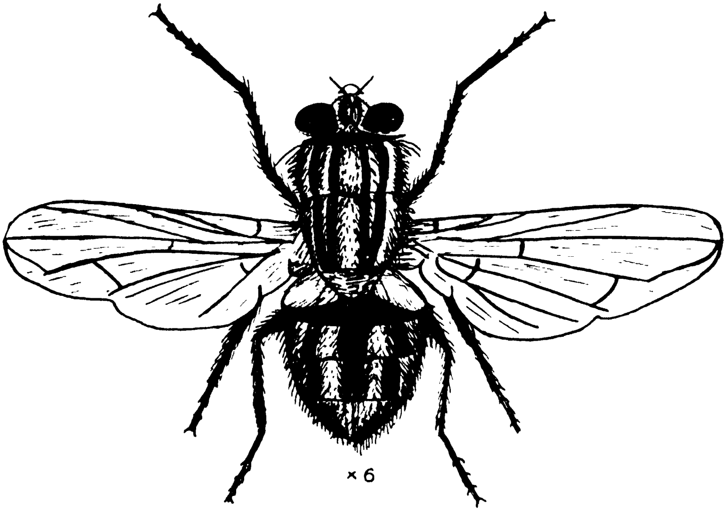

FIG. 23.—Adult House-Fly.

On magnification the head of a female fly is seen to have its eyes further apart than in the male. The underside has a structure, the proboscis, which is formed of the mouth parts and is adapted for sucking and passing saliva on to its food.

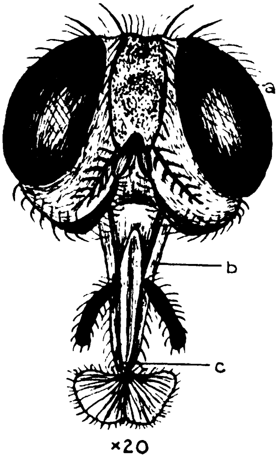

Fig. 24.—Front view of head of House-Fly with proboscis extended, showing (*a*) compound eyes ; (*b*) proboscis ; (*c*) mouth.

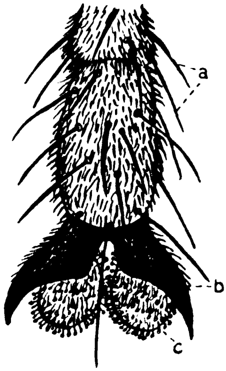

Fig. 25.—Leg of House-Fly. Much enlarged. Showing (*a*) hairs ; (*b*) claws ; (*c*) pads with sticky hairs.

The proboscis, which terminates in two soft lips, is extended during feeding but is tucked under the head when not in use (fig. 24). The thorax and its structures are well adapted for the habit of flying, alighting safely, and walking quickly. It has a first pair of well-developed wings, a pair of balancers which are the second pair of wings modified, and three pairs of bristly walking legs. Each of the latter has two sticky hairy pads which help the fly to cling securely in whatever position the fly alights, even when upside down (fig. 25). The distinctly segmented abdomen is covered with bristles and has spiracles at the sides. The female has an egg-laying apparatus.

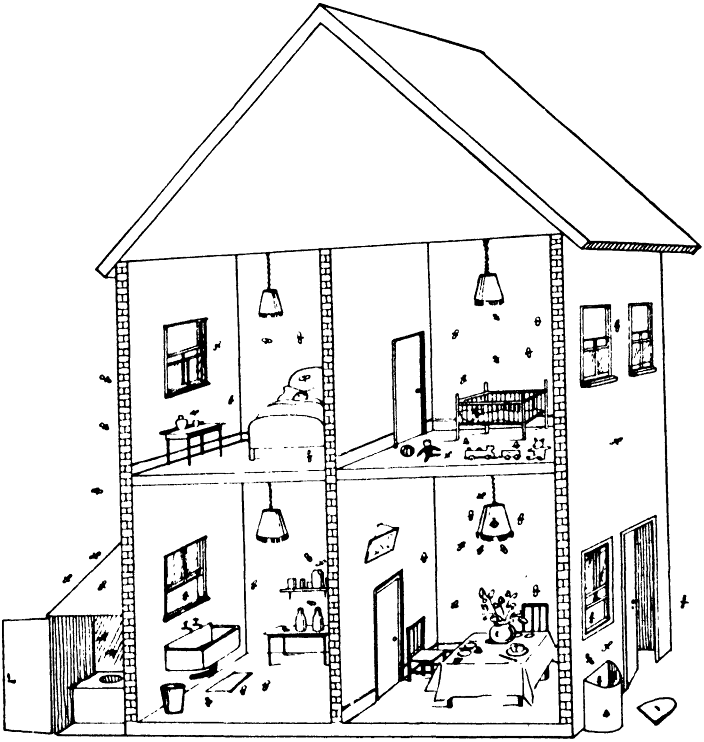

FIG. 26.—Sectional View of House showing whereabouts of House-fly. ((Diagrammatic).

Is the house-fly a serious pest?

Since the house-fly frequents both clean and filthy places in the home and surroundings and can alight almost anywhere, it is a serious pest (fig. 26). It is perfectly adapted for conveying bacteria from the filthy places where it goes to lay eggs, to our food which it eats. The bristle-like hairs which cover the body and legs and the sticky fluid secreted by the pad at the end of each foot are ideal for conveying filth from place to place.

What harm is done?

Musca domestica is known to transmit the disease-germs causing typhoid fever, infantile diarrhœa, and dysentery, and also the eggs of parasitic worms. These are easily conveyed to human food when a fly has just come from laying her eggs in a filthy place where there is human excrement. Not only do her legs leave the filth on the food as the fly crawls about, but, if the fly has fed upon human fæces containing disease-germs, these may be regurgitated or excreted on our food. This is a serious matter as a fly prefers food such as milk, sugar, jam, much of which we do not cook before eating.

During which part of its life is it a pest?

Only the adult fly is an actual pest in the home, for at this period in its life it depends principally on our food for nourishment. Besides actually carrying disease germs, the presence of a number of flies causes considerable annoyance. The eggs and young forms are usually found in manure heaps or human excrement out of doors, but sometimes eggs and young are found in household refuse.

What are the habits of the house-fly?

The house-fly spends its time flying from food to breeding place, alighting periodically *en route*. It is active during the daytime, the males and females collecting together at a breeding place. House-flies are migratory insects, and although in a crowded area they may only travel up to two miles in search of food they are reported as travelling three times as far in the country, and in a wind may be blown along even further than six miles. In travelling long distances they periodically alight. The house-fly is a warm-weather visitor appearing in numbers in the house during July and August. Their numbers depend on such factors as availability of breeding places, warmth, moisture, and food supplies. Occasionally house-flies are seen during other months, usually after some unexpected warm unseasonable weather; this is because some latent young forms (pupæ) hatch out in the favourable temperature. It is generally understood that the adult fly cannot rest (hibernate) during cold weather but that the immature resting stage (pupa) can do so, and some unexpected warm weather may cause a few flies to hatch out. If a breeding place is near, the females lay their eggs, the parents die, and the eggs very slowly develop into pupæ and await the next warm spell.

The feeding habits of the house-fly are most important both from the aspect of control and of conveying disease to man. The sucking proboscis is adapted to lap up liquids such as milk, perspiration, pus, urine. The fly can also feed on solid substances such as sugar, jam, fæces, and garbage, by pouring saliva down the proboscis on to the solid matter to soften and dissolve it before sucking up the liquefied food. Then, too, the fly often regurgitates fluid food taken in at a previous meal. These " vomit drops " not only help to liquefy solid food but often contain disease-germs, which are thus left on human food. These " vomit drops " are left visibly on window-panes and other transparent surfaces as small light-coloured opaque spots; similar but darker spots are due to the deposit of waste which has passed through the digestive tube. It is obvious that the filth deposited by the fly is not confined to places easily visible to us, but is in every place accessible to the fly, including the skin and clothing of members of the household.

How long the fly lives is a debatable point.

Life-history of the house-fly.

The female house-fly lays her eggs where there is some warmth and an available food supply when the egg hatches. Hence new fermenting horse manure or exposed human fæces are often selected, but any rubbish which contains decaying matter or is contaminated with excrement is a possible breeding place for flies. Thus household garbage with its rotting waste matter is sometimes selected. The eggs are pushed just below the surface by the parent and are closely packed together. The female lays up to 120 eggs at a time and she does this at least six times and often many more within three or four days Usually a group of female flies congregate to lay their eggs at the same time. The eggs are creamy white cylindrical structures $\frac{1}{24}$ in. long with two parallel ridges running lengthwise (fig. 27). The egg hatches out into something totally unlike the parent in appearance and habits, and so there is complete metamorphosis in the life-history of the house-fly. The egg hatches out into a larva (maggot) in about a day if the temperature is suitable; otherwise hatching is delayed. The first larva (fig. 28) is a white footless maggot which takes in nourishment and is about $\frac{1}{10}$ in. long. The maggot has no distinct head and is adapted for boring, with mouth parts adapted for sucking. The maggots keep just under the surface of the manure or garbage, but tend to wriggle to the surface at night. Usually at the end of two to five days moulting occurs and the second larva, very slightly different from the first except in size, feeds and grows. The second moult occurs at the end of a day if conditions are favourable, and the third larva (maggot) grows rapidly (fig. 29). This segmented footless creature becomes $\frac{4}{10}$ in. long, after which it ceases to suck up food and grow. Now the yellowish waxy-looking maggot migrates from the region of the food to a drier and non-fermenting spot, and may wriggle by the aid of two tiny hooks in the vicinity of the mouth, from 2 in. to 100 ft. in search of a suitable place. The latter may be in the upper surface of the soil or in the straw at the outside of a manure heap. Having found a resting place the maggot contracts and the skin becomes a puparium, or covering shell, which is creamy white in colour and later mahogany brown, and hardens considerably. The

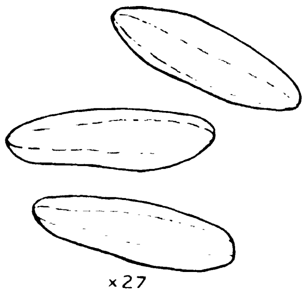

FIG. 27.—Eggs of House-Fly showing the two ridges. (After Patton.)

breathing tubes of the larva become disconnected from this puparium and the larval structure inside completely breaks down and forms a pupa which communicates with the air by two other spiracles which penetrate the puparium. The pupa can rest as a motionless object for a very long time in its barrel-shaped puparium ¼ in. long (fig. 30). The adult fly emerges by cutting the puparium case at one end and pushing up a cap thus formed. This fly, a soft-bodied, pale, wizened creature with crumpled, unfolded wings, forces its way, by means of a special bladder-like contrivance at the front of the head, to the surface of the earth. Here it crawls about, the skin hardens, bristles develop, and the scales form giving the characteristic colour and markings; the wings expand and the mature fly, either male or female, flies away in about one hour's time

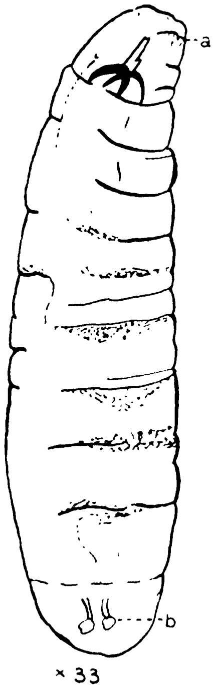

FIG. 28.—First larval stage of House-Fly showing (*a*) mouth; (*b*) spiracles. (After Patton.)

seeking food and a breeding place. Usually the male and female flies come together near some breeding ground during the first days of their life, and in from one to nearly three weeks the female begins laying eggs, which she continues to do during the rest of her short life.

The periods of time taken to develop from one stage to the next in this indirect development, and the time which elapses between the release of the female fly and the commencement of her egg-laying, are determined by a series of factors. The larval stages are affected by type of food and temperature; the length of the pupal stage is determined by temperature; the date of pairing, and the female subsequently ovipositing, are affected by larval food supplies, humidity, temperature.

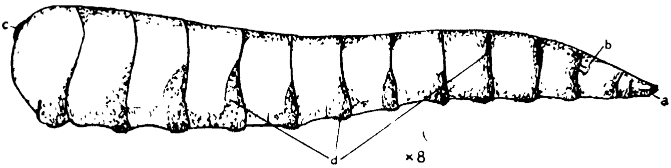

FIG. 29.—Third larval stage of House-Fly showing (*a*) hooks at mouth; (*b*) anterior spiracle; (*c*) posterior spiracle; (*d*) minute spines. (After Patton.)

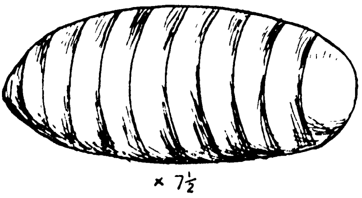

FIG. 30.—Puparium of House-Fly (chrysalis-case). (After Patton.)

The adult flies do not grow nor moult, and normally they are of uniform size. The smaller house-flies one sees in the house are quite a different species, with different habits, and are not so harmful as the true house-fly. Occasionally, however, an adult house-fly is of smaller size than normal due to a limited food-supply during the larval stage.

How to prevent this pest.

The best way of preventing this pest is to give no opportunities for breeding. Now these are very numerous since the storage and removal of waste is a problem which confronts not only the housewife but the municipal authority, gardener, and farmer; for it is household refuse, rotting vegetable and animal waste, and stable manure, which are potential breeding grounds for the house-fly. The housewife can therefore do much to help in prevention by keeping all garbage constantly covered and burning as much as possible regularly. Most houses in this country are now compelled by law to have dustbins with lids, and water closets; the latter should be kept clean and in working order. In certain country villages where dry lavatories are still used there is now more attention paid to the regular covering of excreta with sand or soil, and its daily removal by the local authority for disposal by efficient burial. The ideal treatment of stables and stable manure is by mechanical and chemical means. Methods of treatment are given in detail in the British Museum (Natural History) Economic Series I and IA. Apart from the prevention of breeding, as many adult flies as possible should be exterminated. The housewife should not attract flies into her home by exposing foodstuffs, and in particular there should be careful screening of larder windows. All food should be covered except when actually in use, and when a meal is over dirty dishes should be washed and put immediately in fly-proof cupboards. Kitchen utensils and crockery should be kept in cupboards since adult flies are apt to alight on and foul any that are exposed.

Simple remedies.

In the home the housewife can prevent breeding, but she can also limit the adult pest by excluding and capturing. Perforated gauze screens over larder windows must fit tightly and be of small mesh. The door of the larder must be kept shut. Foodstuffs known to be especially attractive to the flies should be kept under fine wire gauze or muslin covers particularly in the summer months. Since house-flies do get into a home through open windows and doors it is essential to know of some means of destroying the adults. This can be done by mechanical means by the use of a fly-whisk, a haphazard method of destruction using up much energy. Another mechanical means is by using some insecticide (there are several on the market, e.g. Flit) which, to be effective, must come in contact with the fly. This is best done by means of a sprayer, but again the method of destruction is haphazard. Fly-papers and traps have the advantage not only of being continuous but they require little looking after, and no energy is expended by the housewife. Flypapers can be purchased, but the housewife can make her own more cheaply. Castor oil (5 parts) and resin (8 parts) are warmed together until the latter is dissolved. The warm mixture can be applied thinly to strips of glazed paper or painted on the outside of an upturned jar. If the paper is suspended or the jar left standing on a saucer (in case the preparation melts slightly on a hot day) a number of flies are caught and die. Unglazed paper is useless but can be glazed and so made unabsorbent by brushing it over with a solution of 1 oz. glue dissolved in 3 oz. water. Any of the resinous solution unused can be kept in an airtight tin and applied, after reheating, to paper or jar.

A cheap simple home-made fly-trap which effectively entices and poisons the fly and also kills any bacteria on the body of the fly is one using formalin. The trap is a bottle or jar with the opening covered with some blotting-paper which is kept moist by two strips of blotting-paper passing from the cover into a liquid which nearly fills the jar. This liquid consists of formalin, sugar, clear lime-water, water in the proportions of 6 parts commercial (40 per cent.) formalin, 3 parts sugar, 50 parts lime-water, 41 parts water. The flies are attracted to the wet cover over the sweet liquid, sip some from the saturated blotting paper, and are poisoned, but are prevented from falling into the liquid. The dead bodies around the trap should be burnt and the paper should be renewed every few days. The ingredients for these traps can be purchased at a chemist's shop (*see* list p. 19).

What to do in a serious infestation.

More rigorous precautions should be taken in the home if there is a constant infestation of flies, and the matter should be reported to the local sanitary authorities so that further steps can be taken in supervising breeding places outside home jurisdiction.

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KEY TO CONTENTS
A — Description of pest.
B — Description of life-history.
C — Effect of pest on man.
D — Methods of control.
E — Good illustrations.
* — If cost is under 1s. 6d.

THE BLOW-FLY (*Calliphora erythrocephala*)

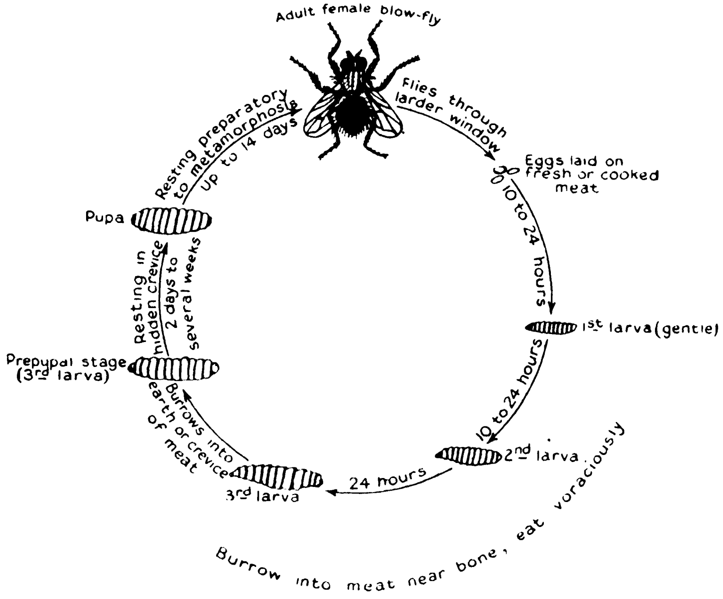
Adult female blow-fly
Flies through larder window
Eggs laid on fresh or cooked meat
0 to 24 hours
1st larva (gentle)
10 to 24 hours
2nd larva
24 hours
3rd larva
Burrows into earth or crevice or meat
Prepupal stage (3rd larva)
Resting in hidden crevice
2 days to several weeks
Pupa
Resting preparatory to metamorphosis
up to 14 days
Burrow into meat near bone, eat voraciously

FIG. 31.—Diagram of life-cycle of Blow-Fly (not to scale). The times stated as spent in the larval stages are for hot summer days.

Kinds of blow-flies.

There are three common varieties of blow-fly in this country. Two of them (*Calliphora erythrocephala* and *Calliphora vomitoria*) are blue-bottles, and another (*Lucilia*) is a green-bottle. In nature they are useful to man as the larvæ eat much decaying animal matter that is left about. The larvæ of

C. vomitoria and *Lucilia* are not seen in the home but depend on carrion for food, whereas the larva of *C. erythrocephala* lives on smaller pieces of meat such as are found in the home. Hence the latter blow-fly comes into the home purposely to find a breeding place, whereas the other two only get into our homes by accident.

Is the blow-fly a serious pest?

The adult blow-fly (*C. erythrocephala*) is annoying, especially if there are numbers in a room, because of their buzzing noise. The fact that they are covered with stiff bristles and can alight anywhere makes them serious disseminators of dirt and possibly of disease. The female fly visits our food to lay her eggs, thus rendering the food unfit for consumption.

What harm is done?

The dirt conveyed on the bristles of the blow-fly's body may contain disease germs, dependent on where the fly last alighted. Since these flies alight out of doors in any filthy spot and also on our food, clothing, and utensils, these flies are the mechanical conveyers of disease. Also much food is ruined because the eggs laid in cooked or uncooked food, particularly meat, hatch into maggots which are a very repulsive sight, making any food quite unpalatable.

During which part of its life is it a pest?

The female blow-fly readily comes into the house and is a constant source of anxiety to the housewife. The larval stage lives and grows at the expense of our food.

What does the blow-fly (C. erythrocephala) *look like?*

The blow-fly, or blue-bottle, which invades the home is one of the largest flies, having a body about $\frac{4}{15}$ in. long and a wing-span of about 1 in. (fig. 32). It is characterized by its bluish metallic colouring. The *head* has two very large compound eyes at the sides, a collection of bright red single eyes on top of the head, two short feelers at the front, and the mouth drawn into a sucking proboscis which can be folded under the head when not in use. Small scales on the head give a red colouring which shows up remarkably against the black hair-like bristles. The *thorax*, armed with strong bristles arranged in rows, has three pairs of hairy walking legs, one pair of membranous wings, and a pair of small balancers. Each wing has the fourth vein bending forwards and is really similar to that of the house-fly. The *abdomen* has a very distinct metallic blue colour.

C. vomitoria, the other blue-bottle which occasionally comes into the house, is similar except that the " cheeks " are black with reddish hairs.

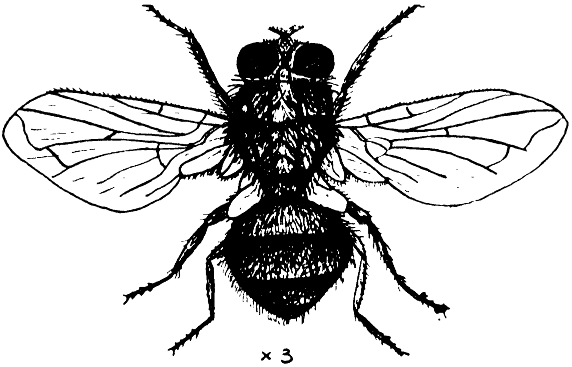

FIG. 32.—Adult Blow-Fly.

Lucilia, the green-bottle which occasionally buzzes round window-panes indoors, has a bright greenish-coloured abdomen.

What are the habits of a blow-fly?

The blow-fly spends most of the time out of doors, and it is the female which invades our homes in search of a breeding place. Blow-flies are found nearly everywhere from March to November; the largest number are seen between May and August, probably because of the very favourable temperature, and the fact that plenty of food is available for the larva since there are so many dead nestlings lying in the gardens and parks. The blow-fly probably tides over the cold winter months in the pupal stage in the puparium, and this is why in occasional warm weather in these months a blow-fly emerges.

Blow-flies are considerably affected by variations of temperature; if below 55° F. they usually hide in an inactive condition in a sheltered place, from which they emerge on the return of warmer conditions.

The female lays as many as 2,000 eggs in a batch on some fresh, decaying, or cooked meat, open wounds, or on dead bodies of birds and mammals, and on offal. They swarm round rotting carcasses in the fields, and round slaughter houses. It is for this reason that freshly killed poultry is protected by covering the broken flesh at the neck, and shot game is wrapped in paper to prevent the flies laying their eggs in the broken skin. Thus there is plenty of larval food for the young blow-fly in diverse places, so that blow-flies are constant visitors to the home. They are powerful fliers and it is known that they can fly many miles searching for a suitable breeding place.

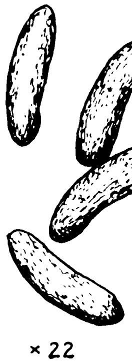

FIG. 33.—Eggs of Blow-Fly. (After Patton.)

Life-history.

The development is indirect, as in the house-fly, and similar stages are passed through, the length of time taken being determined by conditions of food and temperature. *C. erythrocephala* comes into the house and usually selects small quantities of meat on which to lay her eggs (fig. 33), which are about $\frac{1}{30}$ in. long. Up to 100 eggs are laid at a time. The other blow-fly seems to prefer large carcasses and seldom spoils food in the home. The three maggot stages are similar in appearance to those of the house-fly. The maggots are sometimes called " gentles," and feed voraciously and moult twice. The third maggot grows to about $\frac{7}{10}$ in. (fig. 34). It then stops sucking the decomposing animal matter, empties its digestive tube (defæcates), and the creamy white object moves away from the food, usually at night, though occasionally it penetrates into a crevice in the meat. Usually, however, it crawls some distance till it reaches a crack or crevice where it buries itself. The larval tissue breaks down and the creature often then lies dormant for some time in what is called the prepupal stage, which may last for weeks if the temperature is low. Ultimately the larva contracts into an oval and the skin becomes a dark brown colour and becomes separated from the living tissue within. The old skin forms a

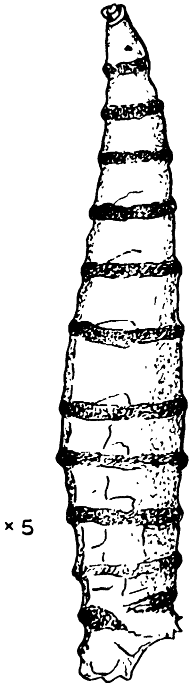

FIG. 34.—Third larval stage of Blow-Fly. (After Patton.)

shell or puparium (fig. 35) and the living creature or pupa inside forms a pupal skin. The breathing tubes of the pupa penetrate the puparium in order that the motionless creature can breathe. After a week or so the adult male or female blow-fly emerges, pushing its way out of the shell through a circular slit it has made. The adult fly walks rapidly, hardens its skin, the males and females pair, and the female flies away in search of a place to breed.

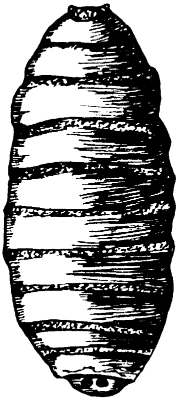

FIG. 35.—Puparium of Blow-Fly. Much enlarged. (After Patton.)

How to prevent this pest.

The blow-fly should be prevented from breeding. This is possible in the house if all food is carefully covered, but it is difficult to prevent blow-flies from breeding away from the home, in slaughter houses and in the fields. Thus adult blow-flies will continue to breed. Hence to prevent the pest in the home the adult fly must be prevented from entering the larder where food is kept. The window should be effectively screened and the door kept shut. Bones and carcasses of birds should never be put in the dust-bin but should be burnt immediately when finished with. The food should be constantly covered when not under observation, for a female can lay her eggs in a very short time. Also the covers should be of very fine gauze and the top of the cover directly over the meat should not be open mesh as the eggs can be dropped through the holes. Needless to say no part of the meat must touch the cover. If at all possible put meat in an efficient meat-safe or a refrigerator. Use the simple fly-catcher and fly-trap for catching the adult blow-fly.

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THE LESSER HOUSE-FLY (*Fannia canicularis*)

Is it a serious pest?

The lesser house-fly is a frequent visitor in the home, alights anywhere both indoors and out, has a body similar to the other flies previously described in that there are innumerable hair-like bristles. This creature is therefore a potential carrier of disease germs in the dirt attached to the body covering.

What harm is done?

No specific disease germs have been proved to be carried by this fly but the larvæ have been found in the human digestive tube and the bladder, which suggests that the eggs had been deposited on some food.

During which part of its life is it a pest in the home?

The male adult fly is a pest as it deposits its excreta and dirt from its body on anything on which it settles.

The female adult visits household garbage in order to deposit her eggs in any decomposing vegetables or fruits.

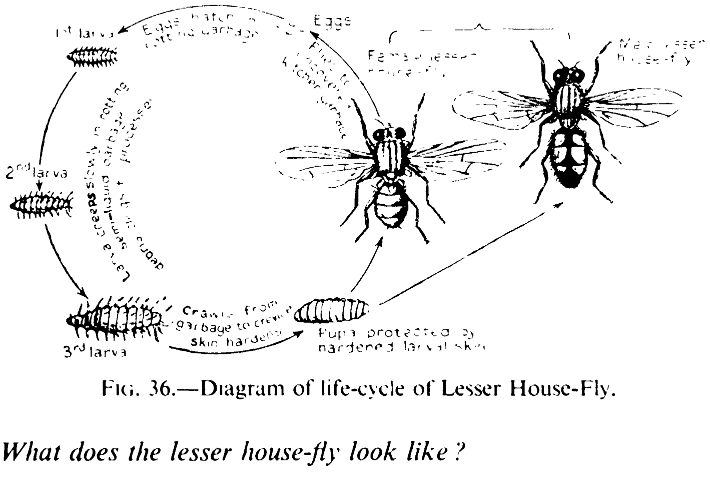
1st larva
Eggs hatch in rotting garbage
Eggs
Female lesser house-fly
Male lesser house-fly
2nd larva
Larva creeps slowly in rotting semi-liquid garbage
3rd larva
Crawls from garbage to crevice skin hardens
Pupa protected by hardened larval skin

FIG. 36.—Diagram of life-cycle of Lesser House-Fly.

What does the lesser house-fly look like?

This fly is distinctly smaller than the true house-fly, and the pair of wings have the fourth vein extending to the wing margin (fig. 37). The mouth parts are prolonged into a sucking proboscis which is folded under the head when not in use. The thorax has three distinct dark stripes. In the male the abdomen is rather narrow and tapering with some yellow patches interspersed on a dark grey background. The female has a more rounded dark grey abdomen.

What are the habits?

In summer and late autumn the male fly is seen circling round the electric light or gas illumination. It settles on bulbs and globes, on the ceiling, and on the food on the table, and stains everything with excreta. The female is attracted only to the uncovered garbage in the house.

Life-history of the lesser house-fly.

The female lays her eggs, up to fifty at a time, in decaying vegetable, fruit, and animal matter, and even human fæces.

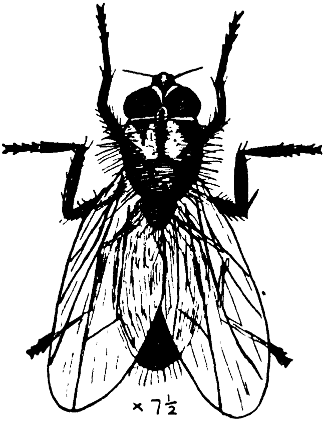

FIG. 37.—Adult Lesser House-Fly, male.

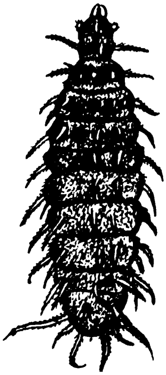

FIG. 38.—Full-grown larva of Lesser House-Fly. (After Patton.)

Development, as in all flies, is indirect, and the egg hatches out into a maggot somewhat similar to those of the house-fly, but with distinctive fine fleshy processes growing from the sides (fig. 38). Much of the debris amongst which it lives becomes entangled in the processes. The maggot moults twice, and the third larva takes on a dark colour and becomes somewhat flattened. The mouth in all cases is adapted for sucking in the semi-liquid food. Ultimately the third maggot leaves its food and seeks a crevice in the floor. The larval skin becomes a puparium and the larval structure inside reorganizes itself and becomes a pupa with its own skin inside, as is the case in the other flies. In this pupal condition the fly looks like something dead and stays thus for several weeks, in fact until a suitable warm day causes the adult fly to emerge.

How to prevent this pest.

Breeding in the house must be prevented if possible, and as many adults prevented from entering the house as possible. Thus all garbage must be covered and no rotting fruit or vegetables left lying about in the vicinity of the home. Screening of larder and kitchen windows with gauze, and the use of traps for killing adult flies are efficacious in limiting the number of the females which come indoors to breed.

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Key to Contents

A Description of pest.
B Description of life-history.
C = Effect of pest on man.
D = Methods of control.
E = Good illustrations.
* = If cost is under 1s. 6d.

CHAPTER XII

COCKROACHES

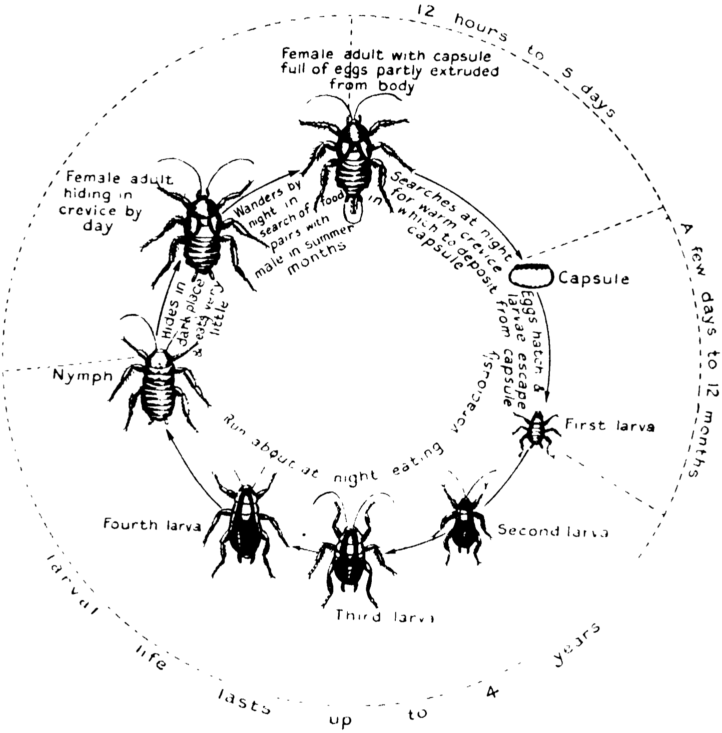
12 hours to 5 days
Female adult with capsule full of eggs partly extruded from body
Female adult hiding in crevice by day
Wanders by night in search of food in pairs with male in summer months
Searches at night for warm crevice in which to deposit capsule
Capsule
A few days to 12 months
Eggs hatch & larvae escape from capsule
First larva
Second larva
Third larva
Fourth larva
Nymph
Hides in dark place & eats very little
Run about at night eating voraciously
larval life lasts up to 4 years

FIG. 39.—Diagram of life-cycle of Common Cockroach. (Not to scale.)

What are cockroaches?

Cockroaches are household insects which, although spoken of as black-beetles, steam-flies, shiners, and croton bugs, really possess characters which are entirely distinct from those of beetles, flies, or bugs. The black-beetle (*Blaps*), which lurks in cellars and outhouses, and occasionally is seen in a house, is a totally different creature from the cockroach, and never appears in enormous swarms in a house like the cockroach often does.

All cockroaches are large insects with a flat body and a well-protected head. Protection is given by a strong plate-like cover and the head is so bent that the mouth faces backwards so that it and the important biting mouth parts are protected from harm. There are usually two pairs of wings, but the first pair is modified as covers, called elytra, of very tough material, affording adequate protection to the delicate second pair of transparent wings when they are folded and not in use.

Kinds of cockroaches.

There are four kinds of cockroaches that are pests of man, but only two are commonly found in English homes. These are *Blatta orientalis*, the common cockroach or " black-beetle," and *Blatella germanica*, the German cockroach, often called " the shiner," " steam-bug," or " steam-fly." Both were brought into Great Britain during the sixteenth century and settled in British homes, constituting a household pest which is becoming increasingly formidable and for which there is still no sure method of eradication.

Two other kinds of cockroaches, *Periplaneta americana* and *Periplaneta australasiæ*, are not usually found in homes in this country, but rather in storehouses and granaries.

Is the cockroach a serious pest ?

The two common house-infesting cockroaches, *B. orientalis* and *B. germanica*, are almost as notorious as the bed-bug. These two insects have closely linked their fortunes with man. The cockroaches invade the home, usually the kitchen premises, where they will have a tolerably high temperature for their well-being and a plentiful supply of food. The fact that they wander anywhere in search of anything edible, for they are omnivorous, makes them highly objectionable. They probably carry much filth and leave it and excreta on our food, cooking utensils, and clothing. They get everywhere and into everything in the home and are serious and disgusting pests. Even though a home may be infested with cockroaches, the housewife may not see many, for they are nocturnal; but she knows of their presence because of the "roachy" smell left on food, and by the destruction they have caused.

What harm is done?

The amount of food they devour is negligible, but the amount they spoil and taint is tremendous. It is possible, but not proved, that cockroaches are carriers of disease germs. Even now it is known that bacteria can pass through the digestive tube without being affected. Since they are voracious eaters they attack man's possessions as well as his food, and spoil books, papers, and clothing, in order to obtain starch from them; they attack leather goods; they fall into liquids, especially sweet ones, and make everything they touch repulsive.

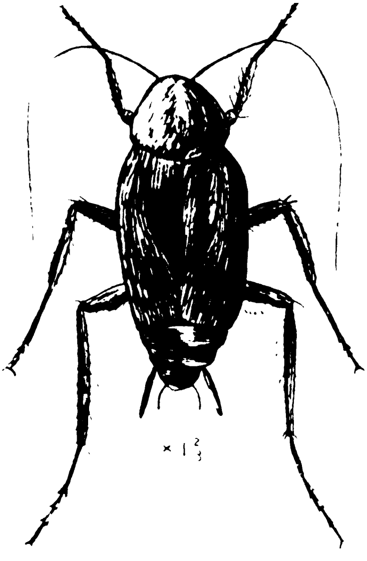

FIG. 40.—The Common Cockroach or "Black-beetle" (*Blatta orientalis*) male.

During which part of its life is it a pest?

The cockroaches, *B. orientalis* and *B. germanica*, spend the whole of their life in man's home. The former is the commonest kind, and if it is present then the latter is not, for never are both kinds found on the same premises. It first of all gets into a home via some furniture, produce, or laundry, either as eggs, young cockroaches, or mature adults. Invasion often occurs from adjacent premises, for example from hotels or restaurants, which are frequently infested, and from which adult cockroaches will often migrate in search of food and breeding places.

What does a cockroach look like?

The common cockroach (*Blatta orientalis*) : the common cockroach or "black-beetle" has a flattened body about

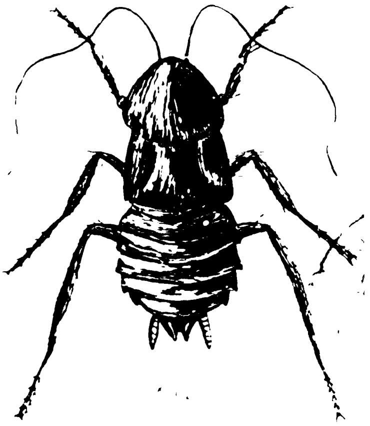

FIG. 41.—The Common Cockroach, female.

1 in. long and is very dark brown, almost black. The *male* (fig. 40) has the wing-covers, or elytra, and second pair of true wings fairly well developed, covering about two-thirds of the back of the abdomen; the wing-ends are rounded, and elytra and true wings are the same length. The *female* (fig. 41) has no true wings with which to fly, and the elytra are short pads not extending over the abdomen. The *head* is well protected by the shield-like plate and cannot be seen from above. Two extremely long feelers appear to come from the protecting plate because of the bending back of the head. The mouth is tucked under the plate and points backwards. It is surrounded by special structures for dealing with the food, and two mouth

parts, the mandibles, act as jaws and have serrated free edges with which to tear food before it enters the mouth (fig. 42). The *thorax* has three pairs of legs somewhat paler than the body and covered with strong bristles. These legs enable the cockroach to run very quickly. The true wings of the male are delicate transparent membranous structures cleverly folded in a fan-shaped manner when not in use so that each is completely protected by the stiff horny elytra. The *abdomen*, with its six segments, is broader in the female since it accommodates the egg-pouch.

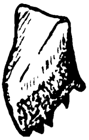

FIG. 42.—Mandible of Cockroach. Much enlarged

Blatella germanica, the other cockroach found in the home, is not so common as the so-called " black-beetle " and is the smallest of the four domestic cockroaches, the body measuring about ½ in. (fig. 43). It is often called " the shiner," and is golden-brown in colour with some dark markings. It hides near hot pipes and radiators, and so is sometimes called the " steam-fly " or " steam-bug." Both sexes in this variety have wings covered with elytra which completely cover the

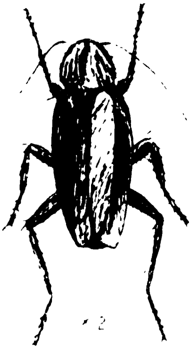

FIG. 43.—The Shiner or "Croton Bug" (*Blatella germanica*) male.

abdomen. In other respects this variety is very similar to the common cockroach (*Blatta orientalis*).

What are the habits of a cockroach?

The cockroach frequents warm places in the house, near kitchen stoves, ovens, hot pipes, and hot-water cylinders, hiding by day in the most unlikely places, for they shun daylight. Their flat bodies enable them to squeeze into the tiniest of niches in dark corners. They come out in search of food in the dark, and some housewives would be amazed to see their kitchen floors at night black with these insects running about searching for food. Crowds of them make a noise like a faint rustling of paper as they move about, and a light suddenly switched on reveals them hurrying to hide from the light.

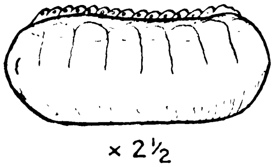

FIG. 44.—Egg capsule of Common Cockroach (Black-beetle).

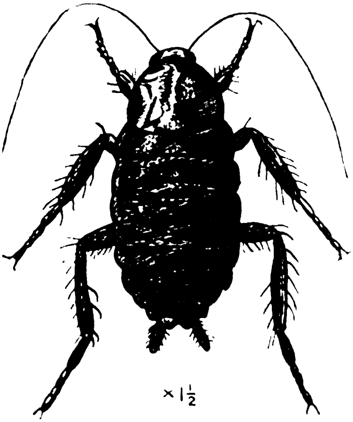

FIG. 45.—Nymph of Common Cockroach or " Black-beetle "

In their voracity they bite at almost anything and seem to get sustenance from it. Saliva is left on whatever they bite with their cutting mandibles, in addition to some excreta, and wax which exudes from the body. Thus they taint everything with which they come in contact, and food, even after being cooked, is often affected if cockroaches have had access to it.

Life-history.

The female *B. orientalis* ("black-beetle") produces dark-brown oblong cases about ½ in. long during the summer months. These capsules (fig. 44), each containing 16 eggs, are sometimes protruding from the abdomen for several days before being placed in a sheltered crevice in some warm place. After a time, varying from a few days to months, the young forms hatch out of their egg-cases and come out of the capsule, which splits along the upper serrated edge. Development is direct, for the young form is similar to the adult, differing only in size, colouring, and in the absence of wings. But the legs are sufficiently well developed to enable the larva to run about very quickly. In a few days the pale yellow creature has become

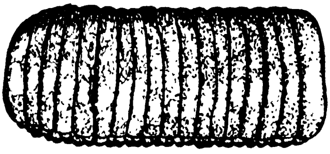

Fig. 46.—Egg capsule of *B. germanica* ("the shiner") (After Patton.

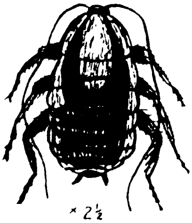

Fig. 47.—Final nymph of *B. germanica* ("the shiner").

dark brown. It grows very slowly indeed, but releases a nymph (fig. 45) which at each moult becomes more like the mature insect. These moults take place at irregular intervals, the times of which vary according to conditions, but the nymphs have the same habits of feeding, running quickly, and shunning daylight as their parents. Usually the last nymph stage, still without wings, is reached after about five moults in four years. This nymph then hides, moults, and the mature insect, with wings typical of its sex, emerges.

The life-history of *B. germanica* is slightly different since the capsule (fig. 46) is carried by the female till the eggs are ready to hatch. Breeding can take place at any time of the year. The released larvæ quickly grow and moult if there is suitable food, and the final nymph (fig. 47) gives rise to a mature adult within six months.

How to prevent this pest.

The cockroach has been a formidable pest in the home for a very long time; there seem to be no vulnerable periods in its life-history which yield satisfactorily to any attack by man, and so the pest still seems to flourish. Little hope of prevention is possible until more facts are known. All the housewife can do to prevent the cockroach infesting her home is to clean thoroughly, and to leave no food about; if the pest is suspected then a repellent such as pyrethrum powder or borax may be used. After rigorously covering all food the powder should be sprinkled on the floor near sinks, stoves, fireplaces, and cracks, each night for several weeks. This will drive many cockroaches elsewhere, but those which remain inadvertently collect the repellent powder on their bodies and may die of suffocation owing to the powder blocking up the openings of the breathing tubes. It is wise to fill in any cracks, especially those near warm pipes and fireplaces, to try to prevent egg-cases being hidden safely from the housewife's cleaning.

Methods of eradication of the cockroach.

The cockroach is the worst household pest to eradicate, but since many homes are infested it is essential for every housewife to know the different ways of attempting to destroy the pest. Destruction of eggs, poisoning through the food, suffocation by means of some vapour which will enter the breathing tubes, trapping both nymphs and adults, are all full of difficulties. Whatever method is used to destroy young or mature or eggs, the attempt is never completely successful. This is because the cockroach is so admirably protected against the onslaughts of man at every period during its lifetime. For instance, it is difficult to destroy the eggs since they are so well protected in the special hardened box which the mother usually hides in a crevice. This is often so inaccessible that contact chemicals cannot be used effectively, and even if fumigation by burning sulphur is resorted to the fumes may penetrate the crevice but not the hermetically sealed box, and so do not affect the eggs. It is also difficult to destroy nymphs and adults by poisoning. Since they eat nearly anything no use can be made of any particular food in which to introduce a poison and so tempt the cockroach to its destruction. If baits of poisoned food (for example, sodium fluoride mixed with some soft food) are left about, it is really an accident if the cockroach happens to select that morsel of food. Also it is amazing how much poison they can withstand. Sometimes a poisonous powder is more effective. For instance, if sodium fluoride is mixed with boric acid or pyrethrum powder in the proportions of 4 parts to 1 part and scattered on shelves and floors at night in a room known to be infested, there is some destruction of the pest. The cockroaches get the powder on their body, especially on the hairy legs and mouth parts. Some of the spiracles (openings to breathing tubes) become blocked, and so the insect is suffocated. Some of the poisonous powder is carried to the crevices where the eggs are just hatching, and the new larvæ devour some of the poison as their first meal and succumb. Also the cockroach has a habit of regularly cleaning its legs with its mouth parts, so that if they are covered with a poisonous powder this is conveyed into the mouth. These methods of using sodium fluoride, either as bait or as a powder, are an easy and cheap way of attacking the cockroach, but it must be remembered that sodium fluoride is a poison, and so all other food must be very well covered to prevent the cockroach from conveying the poison to it. Children and pets must be kept away from it.

Fumigation is a fairly successful way of dealing with nymphs and adults, but, of course, many are not destroyed but only driven out of the home to other homes. A housewife can fumigate by burning sulphur, having taken adequate precautions against fire, removed all metal goods and sealed up the room. But it is a difficult matter to fumigate the kitchen and larder of a home since all foods would have to be removed, and the room left sealed for at least twelve hours, and unusable for an even longer period.

Since it is very difficult effectively to fumigate the crevices where the cockroach lurks, and since it is difficult to leave poisonous bait and powders about, many housewives have to rely on *traps* to catch the pest. There are many simple cheap traps which the housewife can devise by taking advantage of the liking of the cockroach for a sweet fluid. A suitable trap is a jam jar containing some treacle or stale beer. The cover of the jar should be an inverted cone of cardboard with a hole as large as a cockroach at the apex of the cone. The cockroach runs in but cannot get out. Unfortunately, negligibly few of the cockroaches infesting a home are caught this way, and the method is scarcely effective in a serious infestation.

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CHAPTER XIII

THE CRICKET (*GRYLLUS DOMESTICUS*)

What are crickets?

Crickets are insects resembling cockroaches in many ways, but differ from them in the fact that they are "leapers," whereas the cockroaches are "runners." At a casual glance a cricket might be mistaken for a grasshopper, owing to the length and position of the third pair of legs, but it differs considerably in other ways.

Kinds of crickets.

There are many kinds of crickets out of doors, but only one, *Gryllus domesticus*, sometimes called the house cricket, becomes a pest in the house.

Is the cricket a serious pest?

House crickets are not very common pests and not formidable in the damage they do to man and his possessions. Occasionally a house, at least the warm kitchen, becomes infested, and if so, they can be very annoying and irritating.

What harm is done?

The chirping noise the crickets make during their activities at night causes much disturbed rest to householders. Sometimes they are destructive, for occasionally they spoil clothing with their biting mouth parts.

During which part of its life is it a pest?

The cricket usually invades the house in cold weather, as it is a lover of warmth. It spends the summer months out of doors on rubbish heaps but returns to the dark corners of the warm kitchen for the winter, making itself heard in the dark evenings.

What does a cricket look like?

The cricket is a winged insect, very pale brown in colour, with a body about 1 in. long (fig. 48). The *head* has one pair of eyes, a pair of long feelers, and has dark brown markings on the upper surface. The mouth has some wonderfully adapted structures which aid in the getting and cutting of food, and a structure (" tongue ") within the mouth which aids in obtaining liquid for which crickets have a craving. The *thorax* has three pairs of well-developed bristly legs, the hind pair being particularly long and muscular to help in leaping. From the back of the thorax arise the two pairs of wings which, when folded, cover the abdomen. The first pair are horny and act as covers, and in the male are responsible for the chirping noise so characteristic of male crickets. The second pair of wings are transparent and folded fanwise over the abdomen when not in use. The *abdomen* has two hairy tapering structures projecting from the end, and the female also has a structure for depositing her eggs.

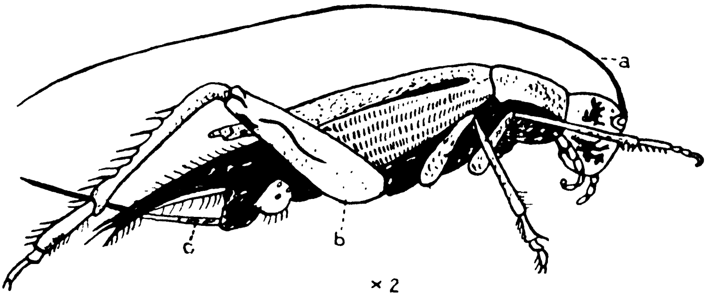

FIG. 48.—The Cricket, female (After Esdaile, after Lefroy.)
(*a*) Long feeler ; (*b*) well-developed hind leg ; (*c*) ovipositor.

What are the habits of a cricket?

The cricket comes into the house in search of warmth and moist food. So it lurks in the kitchen where it is warm and where often it has access to kitchen refuse. Since it is nocturnal it hides in crevices by day and comes out in the darkness. The male attracts the female by the chirping noise it makes.

Life-history.

Development of the cricket is direct in that there is no resting pupal stage before the last moult, when the winged insect emerges. As far as is known eggs, which are found in crevices in houses, are laid only once yearly. These hatch into larvæ which are small immature adults without wings. After a number of moults and nymph stages (fig. 49), probably seven in all, the adult emerges without any suspension of activity.

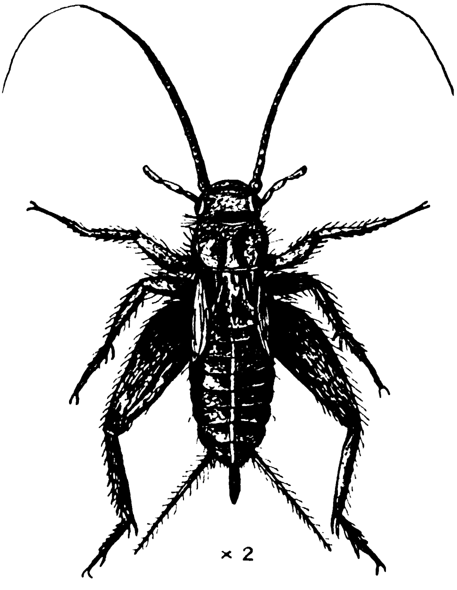

FIG. 49.—Nymph of Cricket. (After Patton.)

How to prevent this pest.

All cracks and crevices should be sealed, especially those near places of warmth.

Simple remedies.

The insect can be poisoned if a paste made of flour, to which sodium fluoride is added, is put on strips of cardboard and left near cracks where the insect lurks by day. Care must be taken not to let children or pets have access to the poisoned bait.

Also advantage can be taken of the cricket's liking for beer and sweetened vinegar. If a deep vessel is half filled with such a liquid the crickets are attracted to it, fall in, and are drowned.

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CHAPTER XIV

BRISTLE-TAILS AND SPRING-TAILS

Bristle-tails (Silver-fish and Fire-brats)

What are bristle-tails?

Bristle-tails are insects with flattened bodies and a long segmented abdomen. They have no wings but move very quickly with their three pairs of walking legs. Very long feelers protrude from the head and three long bristly tail-like appendages from the end of the abdomen, thus giving rise to the popular name.

Kinds of bristle-tails.

There are a number of different kinds of bristle-tails, but the two which are fairly common household pests are the silver-fish (*Lepisma saccharina*), often called the fish-moth, silver-moth, fish-insect, or slicker, and the fire-brat (*Thermobia domestica*, sometimes referred to as *Lepisma domestica*).

Are bristle-tails serious pests?

Both the silver-fish and the fire-brat may do considerable damage in the home wherever there is anything containing starch or sugar, the food upon which they live. The silver-fish is a starch-lover and may be a serious pest causing considerable injury to books, papers, starched clothing, and furnishings. The fire-brat is not such a serious pest, but is very objectionable in kitchens, as it hides in warm places where farinaceous and sugar commodities are stored and often falls into food receptacles. Since both kinds of bristle-tails like warmth there is a tendency for an increase in these pests during recent years owing to the introduction of central heating into many homes.

What harm is done?

The silver-fish (*L. saccharina*) does much injury to books and documents, the paper being attacked by the insect in its search for starchy material, and often the ink is so scratched that printing becomes unreadable. The binding of books, the gum of labels, and the mounting of photographs are all impaired by this insect's feeding habits. Stored starched clothing, linen, lace, and muslins, are often riddled with holes due to the activities of the starch-loving silver-fish.

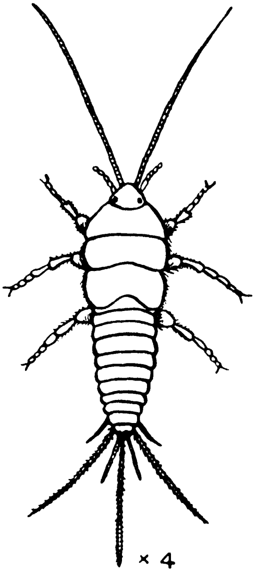

FIG. 50.—Adult "Silver-Fish"—dorsal view. (After Esdaile.)

As far as is known no serious harm can be attributed to the fire-brat (*Thermobia domestica*), but the fact that it wanders about our stores of farinaceous and sugary foods and then travels back to the cracks and crevices where it hides by day is not conducive to cleanliness, and is very unpleasant. The presence of a number of these pests running quickly amongst food is very disturbing to the housewife.

During which part of its life is it a pest?

Since the bristle-tails spend the whole of their life in the home they are pests from the time of hatching, for both young and mature forms live on the same kind of food.

What do bristle-tails look like?

The silver-fish has a small silvery coloured elongated body with scales, which give it a glistening appearance. The body is about ⅓ in. long and tapers gradually from the head to the tip of the abdomen (fig. 50). The head has some long slender feelers and a mouth with structures adapted for biting. The mandibles or biting jaws are long and narrow and serrated at the free ends. The thorax has no wings, and although the three pairs of walking legs are not abnormally long they enable the insect to run extremely quickly. Each leg terminates in a claw. The abdomen with its ten segments is a somewhat flattened tapering structure. Three long narrow processes covered with bristles are produced from the last segment, and are practically as long as the body.

The fire-brat is similar to the silver-fish in all essentials of structure (fig. 51). It has a slightly broader body, is about ½ in. in length, and is different in colouring since many of the covering scales are dark, so giving the insect a banded mottled appearance.

What are the habits?

Both kinds of bristle-tails are nocturnal creatures and shun daylight; if disturbed whilst feeding they run very quickly into a dark crevice. It is almost impossible to catch a bristle-tail because the covering of scales makes it slippery to the touch. A housewife who omits to clean her dark cupboards and crevices regularly and thoroughly may be quite unaware of an infestation of bristle-tails. Occasionally she may see a fire-brat which has become stranded in some steep-sided receptacle into which it has fallen, or she may see one quickly retreating into a dark corner. Similarly, silver-fish are frequently only evident in the damage which they do to books and papers and stored linen. It is known that silver-fish develop very slowly and can withstand long periods without food.

Life-history.

Development in the silver-fish is direct, there being no quiescent stage corresponding to the pupa of many insects, and no acquisition of wings. The female usually lays about 6–10 eggs at a time in crevices or in folds of starched clothing.

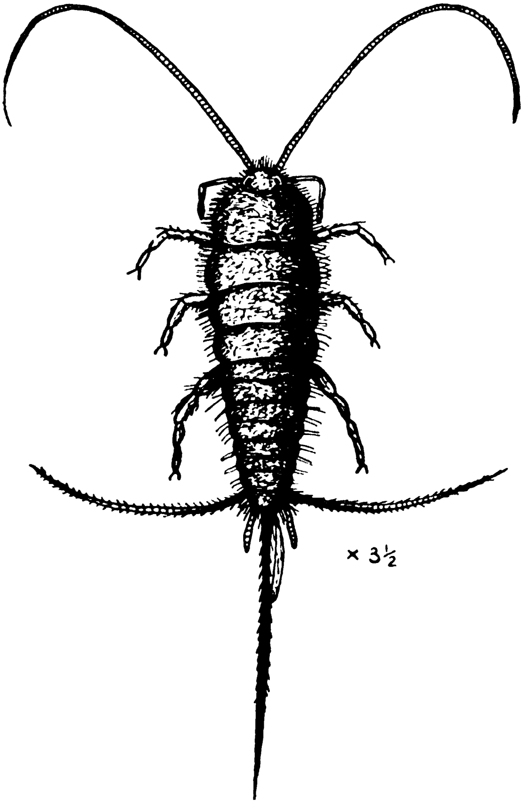

FIG. 51.—Adult " Fire-Brat "—dorsal view. (After Patton.)

Spring is usually the time when the eggs are laid. The eggs hatch into larvæ in 6–9 weeks, according to temperature. Each larva is really a miniature adult, differing only in size, proportions of the parts, and in depth of colour, since scales are absent. The larva eats, grows, and quickly moults into the first nymph. Repeated intake of meals followed by growth and subsequent moulting occurs three more times before the adult stage is reached. It is estimated that growth and moulting in this insect take place so slowly that two years may elapse between the egg and the mature adult. It is recorded that after becoming mature the female lives only a few months, but adults have been kept in captivity for nearly a year, and without food for a considerable time.

The life-history of the fire-brat is not recorded, but it is considered to have a similar life-history to that of the silver-fish.

How to prevent the pest.

To prevent an infestation of the silver-fish it is essential to maintain constant dusting and cleaning of shelves and cupboards where goods containing starch, glue, size, etc., are stored. Starched clothing and furnishings should be frequently handled and aired. If valuable papers are put away for storage they should be tightly wrapped in brown paper and the edges sealed with gum; they should be examined regularly. Since the life-history is so long it is only goods left undisturbed for a long time in a warm, rather damp place, that tend to be infested with silver-fish. Thus, to prevent the pest, clean regularly, and store starched things in a cool dry place.

The fire-brat, too, prefers a warm moist home with food near at hand. Thus all cracks in brickwork, especially near the kitchen range and in cupboards where food is stored, should be effectively sealed.

Simple remedies.

If bristle-tails infest the home, then besides sealing cracks and cleaning carefully to prevent the hatching of eggs, the living nymphs and adults must be killed. The frequent dusting of pyrethrum powder in the infested parts repels the silver-fish, but to kill it recourse must be made to poisoning. For this purpose advantage is taken of the insects' liking for starch. Add 12 parts of sodium fluoride to 100 parts of flour and mix to a paste with water. If this paste is then put on one side of small pieces of flexible cardboard, which are then rolled into small cylinders with the paste inside and left in the affected parts, the insects are attracted to the bait, are poisoned and can be collected and burnt. An alternative is to mix sodium fluoride with glue and apply as before to the inner surface of the rolls of cardboard.

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A Description of pest.
B Description of life-history.
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D Methods of control.
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SPRING-TAILS

What are spring-tails ?

Spring-tails are tiny insects similar to bristle-tails in having a long segmented body and no wings (fig. 52). They possess a forked tail-like appendage. As their name implies, they can leap or spring for a considerable distance somewhat in the manner of a flea.

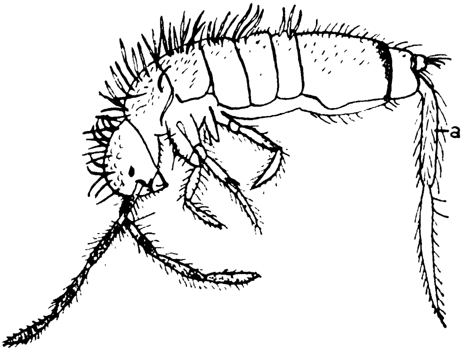

FIG. 52.—Spring-Tail showing (*a*) tail-like appendage. Much enlarged. (After Patton.)

Is it a serious pest ?

Though troublesome if present, spring-tails can hardly be regarded as a serious pest.

Habits.

Spring-tails frequent damp places, usually out of doors, but occasionally they get into damp cellars and basements of houses where they may get trapped in vessels containing milk or other liquids.

Prevention and control.

Owing to their preference for damp places spring-tails can be checked by keeping cellars and basements as dry as possible, and if feasible the source of the dampness to walls and floors should be remedied. Slaked lime and sulphur spread on the floor will do much to discourage this pest.

REFERENCES

AUTHOR	TITLE	CONTENTS
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CHAPTER XV

BOOK-LICE

What are book-lice?

Book-lice, often called Psocids, are minute dirty-white insects, usually without wings, and having biting mouth parts.

Kinds of book-lice found in the house.

The book-louse (*Troctes divinatorius*) is the most common variety found in homes, where it lives amongst books and papers, especially those left undisturbed ; it also frequents any jars or tins which have been left for a long time containing remnants of farinaceous foods. It also lives on straw, and so is found in the straw covers of wine bottles and in straw-filled mattresses. Another psocid (*Atropus pulsilatoria*) is occasionally found in books and among papers; it has some very small elytra, and, like *Troctes divinatorius*, it runs quickly in a louse-like manner. A third psocid (*Cæcilius pedicularius*) is only very occasionally found in the house; it has very well developed wings and frequents upholstered furniture and mattresses.

Is the book-louse a serious pest?

This louse is not usually a serious pest since it is only in numbers that it is objectionable, and there are seldom numbers of book-lice in a home, especially one where books and papers are disturbed frequently. If books and book-shelves are swarming with these lice it means that books and shelves have not been cleaned for a very long time. A swarm of book-lice in a house is frequently traceable to a little-used straw mattress; straw seems to be a favourable place for the breeding of book-lice.

What harm is done?

No material damage is done to property or members of the household. It is very disquieting, however, to see the tiny little creatures hurrying across the pages of a book or swarming in a kitchen cupboard where a tin may have been left containing the remnants of sugar or flour. Occasional serious infestations, traced to some straw mattress, have been reported, which have caused serious mental anxiety and discomfort to members of a household.

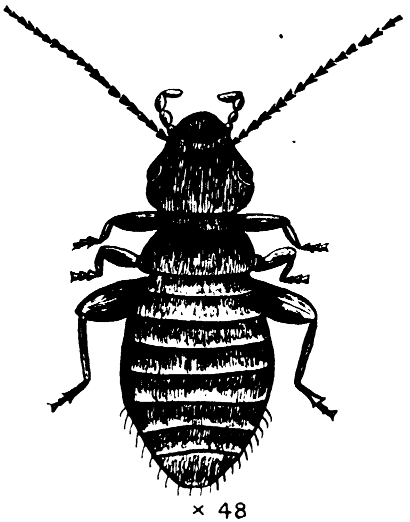

FIG. 53.—The " Book-Louse "—dorsal view.

What does a book-louse like like?

The book-louse (*A. divinatoria*) is about $\frac{1}{25}$ in. long and is greyish-white in colour (fig. 53). The head has a pair of hair-like feelers and very remarkable mouth parts adapted to form a " pick." The thorax is very small and has three pairs of walking legs. It has no wings, but the variety *pulsilatoria* has a minute pair of elytra.

What are the habits of a book-louse?

These creatures run very quickly but occasionally pause in their running in a very characteristic way. The " pick " of the mouth has been said to knock against the surface on which the creature is moving, making an audible ticking sound; hence the name " death-watch " which is sometimes given to these creatures, since the noise resembles that made by the death-watch beetle. They feed on the starch in the paste of book-bindings and on similar material in the kitchen cupboard.

Life-history.

Little is known about the life-history of psocids, but it is thought that straw is a favourite breeding place of book-lice and that the eggs develop into miniature adults.

How to prevent this pest.

Do not leave " empty " jars or tins which contain sugar or starchy foods in the kitchen cupboard. Dust thoroughly books and papers, and the shelves where they are stored, at regular intervals. Avoid using straw for stuffing mattresses or bolsters, especially those not required for frequent use, since they tend to become damp and encourage the increase in numbers of this pest. Psocids prefer dampness, and it is therefore important to keep possible breeding places well aired and dry.

Simple remedies

If book-lice are suspected amongst books and papers it is advisable to put a dusting of pyrethrum powder on the shelves after washing all woodwork with water to which carbolic has been added. Carefully dry shelves before replacing books.

What to do in a serious infestation.

In a very serious infestation, which is unlikely, all carpets and bedding should be sent to clean, wallpaper should be removed, and the walls washed with water to which formalin has been added (15 parts of water to 1 part of formalin). Fumigation with sulphur dioxide is a certain method of eradication. This entails sealing up the room completely, removal of metal fitments, and burning 3 lb. sulphur in a room 12 ft. square and leaving the room sealed for twenty-four hours.

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CHAPTER XVI

BEETLES

What are beetles?

Beetles are insects which have a very strong horny outer covering. The first pair of wings are modified as covers (elytra) for the delicate second pair of membranous wings when these are not in use. The wings and the elytra usually completely cover the abdomen when the insect is not flying. Some beetles have no flying wings and as a result the elytra are short. All beetles have mouth parts adapted for biting food, and therefore have well-developed jaws called mandibles. Development is indirect, for the egg passes through several stages, including a quiescent stage, before the adult appears; hence metamorphosis is characteristic of all beetles.

Kinds of beetles.

The majority of beetles are terrestrial, but a few have taken to an aquatic mode of life. Of the former, many invade the home, some accidentally, others for a special purpose. Some of these spend all their lifetime in the home, but others are only temporary visitors.

Beetles which invade the home.

Accidental entrants to the home, like the "blistering" beetles, and temporary entrants which come in for a definite purpose, like the "dung" beetles, do not invade homes in a temperate country like England. The beetles which enter homes in this country either on food, clothing, furniture, or by their own efforts, usually make some part of the home their permanent habitat for living and breeding. Some of them make wood their principal habitat; others settle in some kind of food; others use carpets and furnishings as their main headquarters. The majority of these permanent inhabitants of the home cause a great deal of damage to provisions, equipment, and actual structure of the home. As previously stated, these beetles undergo a metamorphosis in their life-history, and it is usually the larval stage which does so much damage in the home.

BEETLES WHICH PREY UPON EQUIPMENT IN THE HOME

Beetles which attack wood in the home.

There are several wood-boring beetles the larvæ of which do much damage to wood by making it "worm-eaten." Long cylindrical tunnels are made by the worm-like larvæ, which bore their way by eating the wood and so make their way to the outer surface of the wood in their self-made tunnels. Here each becomes a pupa or chrysalis which rests just beneath the outer surface of the wood. Ultimately the adult beetle emerges by cutting its way through the last ¼ in. of wood and then flying away, leaving the "worm-hole." The size of the hole, together with the dust which falls out of it, indicates which kind of beetle has emerged, and also that probably many more larvæ of the same kind of beetle are still in the wood. The presence of worm-holes in furniture does not necessarily mean that it is infested, especially if no dust is ever seen in the vicinity of the holes. The beetles may have left the wood via the holes several years previously, and it may be that no larvæ are left tunnelling in the inner parts of the wood. Active work by the larvæ is known to be going on if, during May and June, new clean holes appear in the surface of the furniture and new piles of sawdust or frass are seen on the floor below the holes. Then, too, some worm-holes are not the places where an adult beetle emerged, but are the open ends of burrows exposed in the sawing of wood during the construction of furniture. This wood was not infested at the time when the joiner was working at the wood, but it had harboured a few larvæ previously, probably when the wood was stacked in the timber yard.

The two groups of beetles which attack wood in the home are the powder-post beetles (Lyctidæ) and the furniture beetles (Anobiidæ). The larvæ of the former only penetrate sapwood of recently seasoned oak, ash, walnut, and sweet chestnut.

Wood such as beech, birch, mahogany, and pine, is not affected. The hard woods have large-pored sapwood through which the Lyctid larvæ can conveniently tunnel. The sapwood is attacked when the wood is stored in the timber yards. The larvæ of the true furniture beetles (Anobiids) attack the same kinds of wood as those of the powder-post beetles, but only after the wood has become thoroughly seasoned; hence old furniture is often riddled by worm-holes of the furniture beetle. It seems as if the powder-post beetles attack the wood first, and much later the furniture beetles attack it, but never are the two kinds of larvæ living there simultaneously.

THE POWDER-POST BEETLES (LYCTIDS)

What are powder-post beetles?

Powder-post beetles are small dark-brown insects the larvæ of which bore their way through wood by eating it, the undigested part being left behind in the tunnel as a fine white powdered dust.

Kinds of powder-post beetles.

There are several kinds of these beetles, at least four frequenting English homes. Of these the commonest are *Lyctus brunneus* and *Lyctus linearus*, both very similar in structure, habits, and mode of development.

Are the powder-post beetles serious pests?

In recent years wood has been used in the structure of the home and in the making of furniture which not only has been unseasoned but has contained a good deal of sapwood. The War years created a shortage of available timber in this country, and an accumulation of wood in stack-yards of other countries. Both these facts encouraged the introduction of the powder-post beetle larvæ into the home. Shortage of wood meant the using of sapwood, which really ought to be rejected since it is unseasoned and results in shrinkage; but more serious still is the fact that sapwood is the favourite home of the larvæ of the powder-post beetle. As a result much infected wood was introduced into the home, especially in furniture made of oak and ash. Long accumulation of wood in the stack-yards meant opportunities for the beetle to lay its eggs on much of the stored timber containing sapwood, and so it became infested with the pest. The infested wood certainly became drier and more seasoned during long storage, but the larvæ thrive in the large pores of dried sapwood. The pest has proved a real handicap to the cabinet maker and furniture dealer, for often infected wood has been used unknowingly, with subsequent loss.

What harm is done ?

Owing to the fact that the larvæ tunnel in the wood and reduce much of it to powder, furniture and other wooden structures become considerably weakened, although this is not always apparent from the appearance. Usually there are several larvæ in an infected piece of wood, and in the course of a year holes appear and fine powder falls out of them when the furniture is disturbed. Sometimes a structure becomes so weak as to collapse, and this entails the renewal of part or the whole of the woodwork.

During which part of its life is it a pest ?

It is the larva of the powder-post beetle which actually does harm in the home when it is tunnelling through wood.

What does a powder-post beetle look like ?

The adult beetle is about $\frac{3}{16}$ in. long, is very dark brown with glossy elytra, and is covered with minute hairs and punctuations, arranged differently in the different varieties of powder-post beetles. The head has two slender feelers, knob-like at the extremities, and a pair of prominent eyes. The thorax, with its three pairs of legs, elytra, and wings, is square in appearance (fig. 54).

What are the habits of the powder-post beetle ?

The female beetle lays her eggs in late spring and summer, particularly in May and June. She places her eggs by means of a special structure into the pores of sapwood in stored timber, and may even cut the wood a little across the grain to ensure that the eggs will hatch in ideal surroundings.

Life-history.

The egg hatches into a grub-like larva which burrows along in the channel in which the egg was laid, keeping parallel to the grain of the wood. A series of moults takes place to accommodate the growth of the larva, due to the nutriment obtained from the wood. Out of doors, in stored timber, growth is not so rapid, and activities may cease in the winter months, but if the larva is in the wood of furniture in the home, then it grows and moults more quickly. The fully grown larva, about $\frac{1}{5}$ in. long, with its curved wrinkled body, has a small head with biting mouth parts, a wide thorax with three pairs of miniature legs, and a slender abdomen with large spiracles widening and bending towards the end (fig. 55). It eats its way almost to the surface of the wood, where it pupates. The pupal or resting stage is the time when reorganization takes place, and at the end of about a month the beetle cuts the last piece of wood and emerges into the outside. It leaves a small hole in the wood about $\frac{1}{16}$ in. across. Some powdered frass falls from the hole as the beetle emerges.

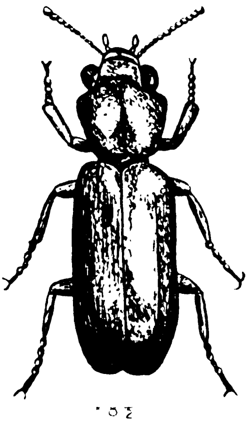

FIG. 54.—Adult Powder-Post Beetle.

How to prevent this pest.

The housewife can do little in prevention of this pest since it infests the wood long before it enters the home. Any female adults which do emerge from infested furniture in the home may find difficulty in laying eggs on suitable sapwood of the harder woods such as oak, since floors and furniture made of this wood are usually polished. The smooth surfaces dis-discourage the laying of eggs, and the polish also acts as a deterrent.

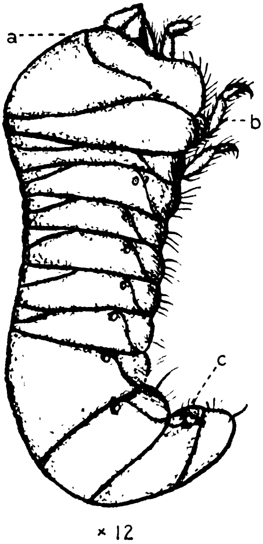

FIG. 55.—Full-grown larva of Powder-Post Beetle.
(After Patton, after Munro.)
(*a*) Head ; (*b*) foot ; (*c*) spiracle.

Simple remedies.

Most of the remedies are not within the scope of the housewife but are the concern of the timber merchant, who should remove the sapwood from his stored wood. If a housewife suspects the pest in some furniture she should use the same methods of control as are recommended for dealing with the furniture beetle (*see later*).

THE COMMON FURNITURE BEETLES

Kinds of furniture beetles.

There are several small beetles which spend the whole of their life in the home, for the most part as grub-like larvæ living in old well-seasoned wood. The larvæ are never seen, nor are the adults often noticed as they move about the house during their short life. Signs of the pest are very obvious since worm-holes are left in the wood when the adult emerges, and small piles of frass are occasionally to be seen in early summer near infested wood. The common furniture beetle (*Anobium punctatum*) is the beetle which usually infests wood in the home, but two others, the death-watch beetle (*Xestobium rufovillosum*) and *Ptilinus pectinicornis* are occasionally found there.

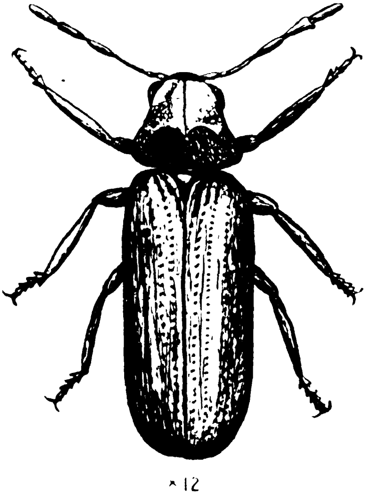

Fig. 56.—Common Furniture Beetle.

Are the furniture beetles serious pests?

The larvæ of these beetles attack flooring boards, rafters, and any furniture made of oak, alder, birch, walnut, beech, and pinewood. Old furniture is often riddled with holes, which is considered by some to enhance the value of antique furniture. Holes, however, indicate the possibility of living larvæ within the wood. This is a serious matter, for not only is that particular piece of furniture being made unstable, but other woodwork in the home, particularly that in the same room, is rendered liable to attack by the pest.

What harm is done?

Woodwork is weakened and destroyed because of the tunnelling of the larvæ, which reduces the wood to a honeycomb of tunnels filled with coarse grains of chewed wood.

During which part of their lives are they pests?

The furniture beetle is a pest during the larval stage, when it lives within wood and destroys it to obtain nourishment.

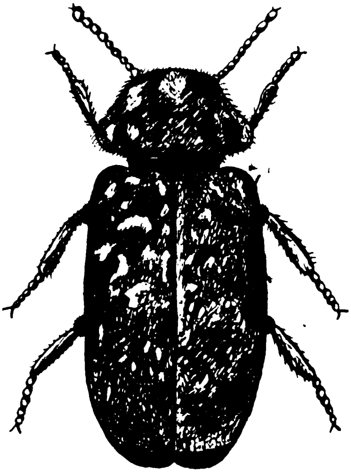

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FIG. 57.—Death-watch Beetle.

What do the furniture beetles look like?

The adult form of the common furniture beetle (*Anobium punctatum*) is about $\frac{1}{6}$ in. long, is dark brown to red in colour, with some short yellowish-grey hairs which affect the colouring in a bright light. The elytra are covered with little pits arranged in parallel longitudinal rows. The back of the head is completely covered with a hard shield ridged in the middle. The head carries two feelers which are swollen at the ends (fig. 56).

The death-watch beetle (*Xestobium rufovillosum*) is larger than *Anobium*, being about $\frac{1}{4}$ in. long, but is the same colour (fig. 57). The arrangement of the short pale-coloured hairs, together with the scattered small pits, gives a mottled appearance. The head has similar feelers, but the thorax is quite distinct from that in *Anobium* as the sides are extended into wing-like flaps.

The small furniture beetle (*Ptilinus pectinicornis*) has a dark brown cylindrical body $\frac{1}{6}$ in. long with characteristic comb-like antennæ (fig. 58).

A few other varieties of *Anobium* are all similar to *punctatum* and occasionally invade the home.

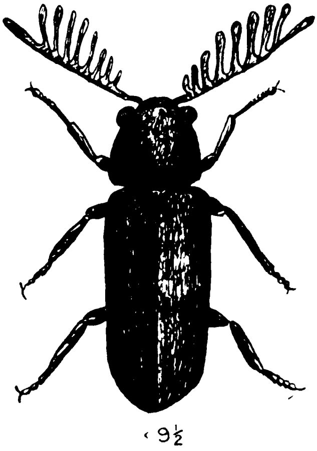

FIG. 58.—Small Furniture Beetle (*Ptilinus Pectinicornis*), male (After Patton.)

What are the habits of the furniture beetles?

The common furniture beetles emerge from the pupal stage just beneath the surface of the wood by gnawing a small hole, by which they escape into the open. This occurs in the months of May, June, and July. The holes left in the wood measure about the width of the body which has emerged, and average from $\frac{1}{24}$ in. to $\frac{1}{16}$ in. The frass which falls out of each hole after the emergence of the beetle is wood dust made up of small grains. The adults fly about the house alighting on walls, ceiling, windows, and woodwork. They readily withdraw feelers and legs at the approach of danger, roll up, and become apparently inanimate. It is difficult to locate them on a dark background, and they do not readily succumb to maltreatment. Mating takes place during the early flying period and the female proceeds to lay her eggs. She searches for some rough, well-seasoned wood, particularly oak, walnut, or birch, where there are many cracks and chipped surfaces. Into such crevices a few oval-shaped white eggs are inserted by the special apparatus of the female. It is not known how many eggs a female lays in her short adult life, but it is known that very few are laid at a time. This process over, the female dies; the male also dies after mating.

The death-watch beetle naturally leaves larger holes ($\frac{1}{10}$ in. to $\frac{1}{6}$ in. across) when it emerges from wood, and the frass is coarser than is the case with *Anobium.* The adult beetle does not emerge immediately after metamorphosis from the pupa, but stays just beneath the surface of the wood where the pupal stage has been spent. The change from pupa to adult occurs in April and May, but it is not until autumn, and more usually the following spring, that the adult death-watch beetle leaves the wood. The adult makes a curious tapping noise on wood by striking it with its head, and other adults reply to indicate their whereabouts. The noise is faint, but in the silence of a sick-room it can sometimes be heard; hence the name "death-watch." The females lay their eggs either out of doors under the dry loose bark of oak, beech, or willow trees, or indoors in rough oak such as in rafters, panelling, beams, and heavy furniture. It is the ravages of the larva of *Xestobium* that have caused such havoc in Westminster Hall.

Life-history of the furniture beetles.

On hatching, the larva begins to eat its way through the wood by cutting with its biting jaws and passing the wood into the mouth, pellets of undigested material being left behind in the tunnels. The tunnels get wider at each moult, probably four in number, and the maggot grows to a size of about $\frac{1}{6}$ in. in length (fig. 59). It has three pairs of very short legs on the first three body segments, and on the other seven segments of the body, which is distinctly curved, there is a double row of small brown spines and well-developed spiracles. The spines distinguish the larvæ of the furniture beetle from those of the powder-post beetle.

Sooner or later, depending on conditions, the larva makes its way to a point within $\frac{1}{4}$ in. of the surface of the wood, where it pupates. The larva enlarges the end of the tunnel and here the chrysalis or pupa lies for a few weeks. The pupa is soft-bodied, and after having undergone fundamental changes the flying beetle emerges. It may take two years or longer for the egg to develop into the adult beetle, and often there are several generations of the beetle in an old piece of furniture, and so it takes years to eradicate them.

The death-watch beetle has a similar life-history. The eggs and larvæ are correspondingly larger than in *Anobium*, and large pieces of wood such as rafters and beams are usually selected.

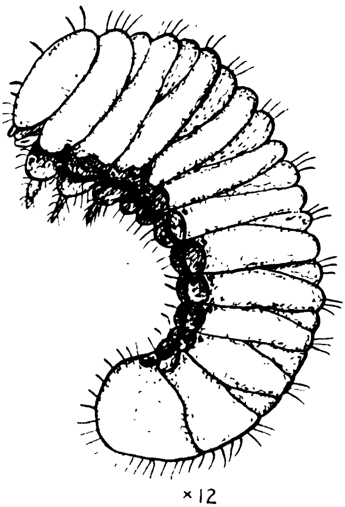

FIG. 59.—Full-grown larva of Common Furniture Beetle.
(After Patton, after Munro.)

How to prevent this pest.

Since it is known that these insects lay eggs on rough surfaces of unpolished wood, care must be taken of such surfaces, especially in old furniture. The purchase of antique furniture is fraught with risk, for it may have been stored with infested furniture, and eggs may have been laid in a crevice or unpolished part just before purchase. It may be two to three years before the beetles emerge, but the larvæ will have been undermining the wood all this time. To prevent eggs being laid, all furniture and woodwork must be kept in good condition by having damaged parts repaired. A polish which contains turpentine or paraffin is a good deterrent, and if rubbed over wood deters beetles from approaching. During May, June, and July, and in early autumn it is wise to rub any wood in a room with paraffin if it is known that furniture beetles may have had access to this room from some infested furniture. If a piece of furniture is suspected of harbouring the larvæ, then seal up all existing holes with soft soap and carefully observe the wood in May, June, and July. If new holes appear it is wise to remove the furniture from the home as it is impossible to kill all emerging beetles with an insecticide. It may take several years for all the existing larvæ to pupate and emerge as adults, so that by the retention of infested furniture there is yearly danger of adults escaping and laying eggs on other woodwork. It cannot be too firmly insisted that the escape of a single mating pair may seriously endanger other furniture in the home. For these reasons the claim of certain furniture dealers to eradicate this pest by one single treatment must be regarded as optimistic, and a sure indication of their ignorance of the life-history of the furniture beetle.

Remedies.

Eradication of the "wood-worm" is extremely difficult because of the deep-seated habitat of the larvæ, especially in large pieces of wood. Attempts at destruction of eggs, very young larvæ, pupæ, and adults, which are near the surface of the wood can be made by the use of insecticides, but these must be used regularly and yearly in infested wood. There are several liquid insecticides which a housewife can apply easily. If, however, only a small piece of furniture is infested and can be placed in a gas or electric oven, then heat can be used. This will so penetrate the wood that all stages of the pest will be killed. The temperature of the oven must be kept at 130° F. for at least six hours. If wooden floors or large pieces of furniture in a room show signs of infestation the housewife can fumigate the room with sulphur dioxide. The room must be hermetically sealed, all metal fittings removed, and 3 lb. of sulphur left safely burning in a room

12 ft. square. After leaving for twenty-four hours the wood in the room should be rubbed over with a deterrent such as paraffin. Fumigation may not be fatal to deeply seated larvæ.

The easiest way of controlling these wood-boring beetles is to apply liquid containing an insecticide to the wood. Especially should this be done in May, June, and July, and in case it is an infestation of the death-watch beetle, in early autumn. Unpolished wood can be washed with water containing plenty of washing soda. If this is done daily for a week the liquid soaks into the wood and kills stages of the pest which are near the surface. This treatment is unsuitable for polished woodwork, and paint is stripped by the action of the soda. Daily washing with paraffin is to be recommended in May and June, and even polished wood suffers little harm by this treatment. The emerging beetles are then killed before they can mate, and drop to the ground, from which they can be swept up a short time after the paraffin treatment.

Several other insecticides are recommended for dealing with this pest, but some of them are unsuitable for use by the housewife and need expert knowledge for their safe handling.

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CARPET BEETLES

The larvæ of several kinds of beetle do much damage to equipment in the home especially to carpets, furs, and feathers. In countries warmer than Great Britain damage is done by some beetle larvæ to every conceivable kind of woollen goods and upholstered furniture, since the larvæ live on wool, hair felt, feathers, and even dust.

Kinds of carpet beetle.

The two best known found in English homes are *Attagenus piceus*, the black carpet beetle, and *Anthrenus scrophulariæ*, the buffalo bug or buffalo moth. *Anthrenus vorax*, the larva of which is called the " woolly bear," is a very common pest in furniture and carpets in India and U.S.A., but as far as is known is not a common pest in this country.

Are the carpet beetles serious pests?

The larvæ of these beetles cause damage to carpets since they live in the dust and fluff in the cracks of floor-boards, and eat the fabric of the underside of the carpet. These larvæ also feed in the folds of any woollen goods if left there undisturbed for some time.

What harm is done?

Holes as wide as 1 in. may be eaten in carpets in lines indicating where the carpet covered the floor-board cracks. In the case of infested woollen material small holes appear along the folds.

During which part of its life is it a pest?

The adult beetles live out of doors, but the female beetle comes into the house to lay her eggs in places where the larvæ will have a plentiful supply of food, such as a carpet.

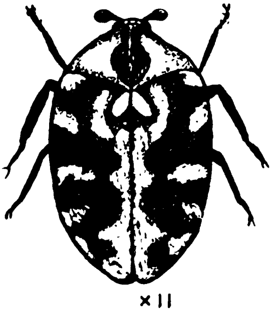

FIG. 60.—Carpet Beetle (Buffalo Bug)—dorsal view. (After Patton.)

What does the carpet beetle look like?

The carpet beetle (buffalo bug) has an oval body $\frac{1}{8}$ in. long. It is a darkish colour but looks mottled because of innumerable small black and white scales; a distinct reddish-brown stripe passes down the middle of the back (fig. 60). The adult is not often seen since it does not live in the home. The larvæ, found on the underside of carpets, are almost $\frac{1}{4}$ in. long when fully grown, brown in colour, and covered with hair-like brown processes (fig. 61). Tufts of these short stiff hairs cover the body and longer hairs are arranged down the sides; from the posterior end of the body a very long tuft of hairs is produced.

The black carpet beetle has black colouring with wing-covers tending to be reddish brown. It is about ⅕ in. long (fig. 62).

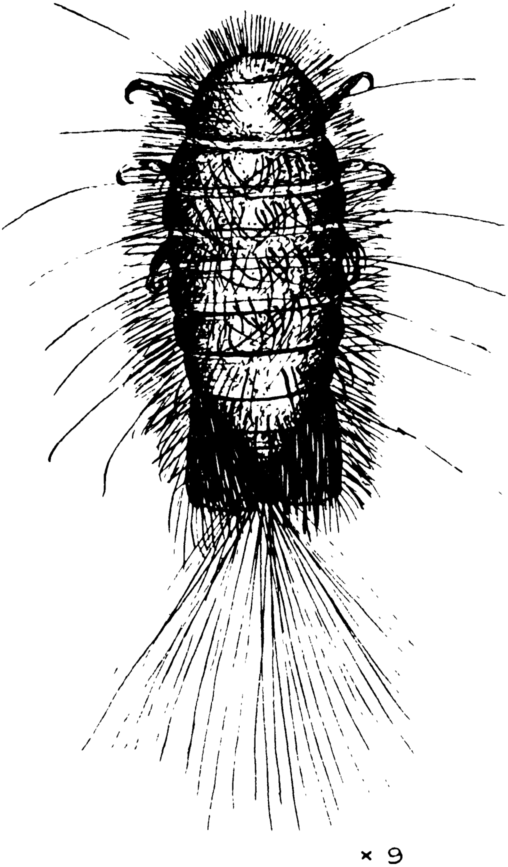

Fig. 61.—Larva of Carpet Beetle (Buffalo Bug). (After Patton.)

The mature female may be seen in the home, but it is the larva which is found under the edge of carpets, along the cracks of floor-boards covered by carpets, in feather pillows, or in hair mattresses. The cylindrical elongate larva is broadest at the front end, is a gold-brown colour, and attains a length of ⅓ in.

before it pupates. It is covered with hairs and from the posterior end a long brush of hairs projects (fig. 63).

What are the habits of carpet beetles?

Both the buffalo bug and the black carpet beetle live out of doors and visit lupins, members of the daisy family, and the umbelliferæ flowers in order to get pollen for food. Pairing takes place out of doors and the mature female comes into the house to breed. Often in autumn these beetles are seen on the window-panes at dusk as they seem to be attracted by the light. The eggs are laid under carpets, and in the feathers of cushions and pillows if an entry can be found through the ticking. This is frequently the cause of "felting," which is due to the larvæ stripping the feathers, thus causing some of the short pieces to stick to the inner surface of the ticking and forming a firm feltwork. The larva is an active creature during the warm summer months, and if it is in a warm room retains its activity throughout the winter, feeding occasionally and subsequently moulting. Pupation usually occurs in the spring, followed shortly by the emergence of the adult, which in April or May can sometimes be seen flying to the windows in an effort to escape into the open, where it can get adult food from the flowering plants. The adult readily feigns death at the approach of danger by bending the head and tucking up the legs.

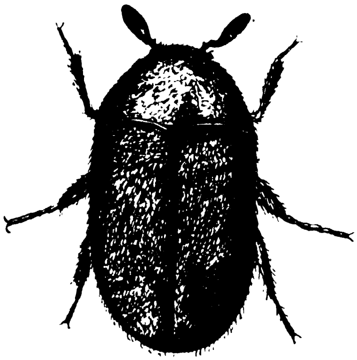

FIG. 62.—Black Carpet Beetle.

Life-history.

The female carpet beetle (buffalo bug or buffalo moth) lays white, somewhat wrinkled eggs, which usually hatch within a fortnight if the conditions are fairly warm. The larva eats, grows, and moults about six times, but activities are determined by temperature and food supplies. It can withstand great cold, and lack of food for as long as ten months, but under favourable conditions it can pupate in two months. The last larval skin splits and becomes a case for the pupa. This resting stage does not last long and often eggs laid in the early summer become mature beetles in the autumn, and begin laying eggs; the larvæ which hatch out feed all the winter if they are in a warm room.

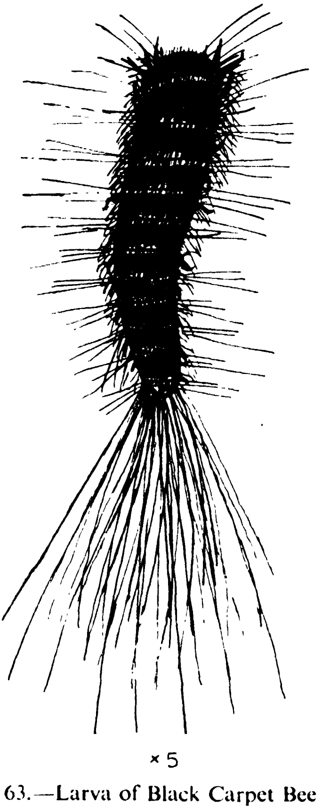

FIG. 63.—Larva of Black Carpet Beetle.

The black carpet beetle lays white fragile eggs which hatch usually in ten days in a warm room. The larva moults up to a dozen times, and the larval skins left under the carpet are so easily mistaken for grubs that a housewife on seeing them might think she had a more serious infestation than was actually the case. The larval stage lasts at least a year and often longer if conditions are unfavourable. Given a warm room and plenty of food the larva becomes fully grown in about a year, and after resting in a pupal condition for a short time, the adult emerges. The pupa is hairy and its white hairs become so entangled with debris that it resembles a very delicate cocoon.

How to prevent this pest.

Carpets, especially fitted ones, provide ideal conditions for this pest, particularly if the carpet is not disturbed for a year. Loose rugs are to be recommended, for even systematic cleaning of a large carpet with a vacuum cleaner fails to disturb any beetles, larvæ, or eggs located under the edges of the carpets and under the carpet along the floor-board cracks. The recent fashion for polished floors and loose rugs, which are easily removable, tends to prevent this pest from establishing itself.

Simple remedies.

If the pest is known to exist, then carpets should be taken up a few times each year for a few years and thoroughly cleaned. The floors should be washed with water containing a disinfectant; the cracks in the floor-boards should be filled up as smoothly as possible to limit the places where dust and fluff can collect and so form harbourages for this pest. A fitted carpet should be cleaned regularly all along the edges.

What to do in a serious infestation.

Fumigation by burning sulphur is the best means of ridding a room of a beetle if carpet, floors, bedding, and pillows, are seriously infested. The room must be hermetically sealed and all metal goods removed because of tarnishing; then 3 lb. of sulphur should be burned in a room 12 ft. square and the room left sealed for at least twelve hours.

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BEETLES WHICH PREY UPON FOOD IN THE HOME

Larval beetles usually enter the home on purchased foodstuffs and live at the expense of it, foul it, and make it unfit for human consumption. Much of the food thus spoilt is flour, meal, and cereals, but some larvæ attack meat, cheese, and condiments. In several cases the adult beetles also live on the food.

The principal larvæ attacking flour and meals are mealworms; these are the larvæ of *Tenebrio molitor* and *Tenebrio obscurus*, and the adult beetles also feed on these foods. Other beetles which live in flour in the larval and adult stages are the flour-beetles *Tribolium confusum* and *Tribolium castaneum* (or *ferrugineum*), sometimes called the red grain-beetle or the rust-red flour-beetle. Also the adult and larval stages of *Gnathocerus cornutus* eat and breed in flour.

The principal beetles which attack grain and cereals include some of the weevils. The chief weevils found by the housewife in her stores are *Sitophilus* (*Calandra*) *granaria*, the granary or black weevil; *Sitophilus* (*Calandra*) *oryzæ*, the rice weevil; *Bruchus pisorum*, the pea weevil. Several other weevils lay their eggs on stores in granaries and seed stores, but do not usually come into the house. There is also a small groceryinfesting beetle very common in pantries and often spoken of as a weevil, viz. *Orzæphilus* (*Silvanus*) *surinamensis*, the saw-toothed grain-beetle, so named because of a number of tooth-like projections at the sides of the thorax.

The principal beetle larva which attacks meat, hams, bacon, and cheese is the larder beetle, *Dermestes lardarius*.

BEETLES WHICH ATTACK MEAL AND FLOUR

Mealworms (The Darkling Beetles)

What are mealworms?

Mealworms are the larvæ of certain black-beetles, and are often found in meal and flour. The adult beetles are similar in certain respects to the large black-beetle called Blaps, which is so often mistaken for a cockroach.

Kinds of mealworms.

The larva of *Tenebrio obscurus* is called the darker mealworm, and that of *Tenebrio molitor* is called the yellow mealworm.

Are the mealworms serious pests?

These mealworms, which are often bred for feeding small captive animals, are serious pests if they are living in flour or meal, for not only do they consume a considerable quantity but foul much more. Since they are prevalent in flour-mills they quite often must be ground up and thus enter into our food.

What does the mealworm look like?

These larval beetles are worm-like segmented cylindrical creatures about 1 in. long and are covered with an extremely tough skin. The darker mealworm, *Tenebrio obscurus*, is very dark yellow; the yellow mealworm, *Tenebrio molitor*, is pale and waxy looking. There are three pairs of walking legs and two dark-coloured spines at the posterior end of the body (fig. 64).

The adult beetles are about ½ in. long and have a somewhat flattened body; the head has two feelers which look like strings of beads. The wing-covers possess about 16 deep parallel grooves. *T. obscurus* is a dull black colour, and *T. molitor* is shining black (fig. 65).

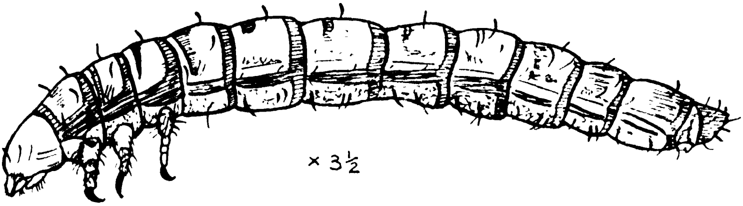

FIG. 64.—Mealworm—the full-grown larva of *Tenebrio molitor*—side view. (After Patton.)

What are the habits of mealworms?

The adult beetles can fly rapidly and do so usually at night. They usually frequent damp places, and attack flour, meal, grain as food, as do also their larvæ. The latter often stray into unusual places and are sometimes found feeding on dried fruits, pepper, dried bread, and biscuits.

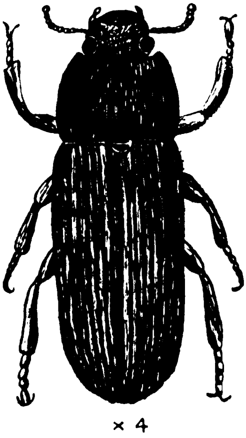

FIG. 65.—Adult "Mealworm" Beetle (*Tenebrio molitor*.)

Life-history.

The female beetle not only eats the flour and meal but lays as many as 500 or more eggs in it. The oval white eggs hatch into very similar larvæ in both kinds of mealworms in about a fortnight, but the time is determined by temperature. Moulting to allow of growth takes place as many as twenty times. These larvæ can go without food for long periods extending to several months, and if they are deprived of flour or meal they will eat grain such as barley, and the bodies of dead insects. Usually they spend about three months as mealworms, and when about 1 in. long the larvæ (fig. 64) crawl to the surface of the food and there pupate. The beetle emerges after a resting stage which may vary from two weeks to several months, according to conditions.

How to prevent this pest.

Since the pest usually enters the home in the mealworm stage in flour, meal, etc., it is advisable that the housewife should not lay in large stores of these commodities. Infestation usually occurs in flour-mills, bakeries etc., where scrupulous cleanliness may not be maintained, and grain and flour are left lying about in crevices, and full sacks are undisturbed for a considerable time. A housewife finding a mealworm in her flour should burn all the flour and wash the receptacle which contained it. She should also keep covered all flour and meal to prevent a nocturnal visit of a female beetle to lay her eggs.

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Flour-beetles

What are flour-beetles?

Flour-beetles are small insects, only ⅕ in. long at most, which lay their eggs in flour or meal or stored grain. Wherever these commodities are stored, such as in bakeries, mills, and shops, they are frequently infested with the pests, which may penetrate into the home on purchases of groceries and any foods made from the commodities.

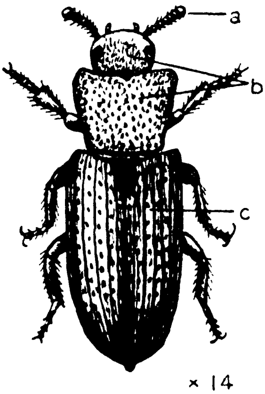

FIG. 66.—Flour Beetle (*Tribolium confusum*) showing : (*a*) club-like feeler ; (*b*) head and thorax with pitted appearance ; (*c*) longitudinal rows of punctures on elytra. (After Patton.)

Kinds of flour-beetles.

There are two very similar kinds of flour-beetles which infest flour, viz. *Tribolium confusum*, the confused flour-beetle, and *Tribolium castaneum* (*ferrugineum*), the rust-red flour-beetle. A third flour-beetle is *Gnathocerus cornutus*.

Are flour-beetles serious pests?

These pests, especially *T. confusum*, are on the increase. The larvæ especially do considerable damage, not only to flour, but to practically all cereal foodstuffs. The adult beetles also get into flour, etc., in their search for food, and cause it to take on a pink appearance in the receptacle in which it is contained, but on exposure to air the infested flour turns light brown. Seriously infested flour usually develops a pungent smell.

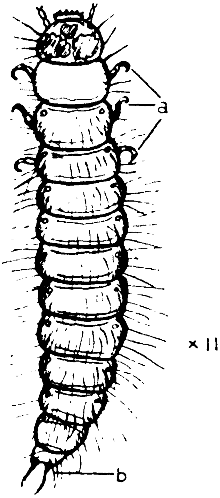

FIG. 67.—Larva of Flour Beetle (*Tribolium confusum*) showing (*a*) three pairs of legs; (*b*) forked last segment. (After Patton.)

What do flour-beetles look like?

The minute *Tribolium* adults are about $\frac{1}{8}$ in. long and have prominent heads with club-like feelers. On magnification, *T. confusum* is seen to have a head and thorax with a pitted appearance because of innumerable round punctures: the oval-shaped abdomen is completely covered by the parallel-sided elytra, which also have longitudinal rows of punctures (fig. 66). The less common rust-red flour-beetle, *T. castaneum*, is very similar except for slightly smaller size. The larvæ of both kinds when fully grown are cylindrical segmented bodies about $\frac{1}{5}$ in. long, covered with short hairs, and the last segment is forked. At first they are white transparent creatures, but after a series of moults they become opaque and a light brown colour (fig. 67). *Gnathocerus cornutus*, another flour-beetle, has some characteristic well-developed curved tearing mouth parts (mandibles) in the male (fig. 68).

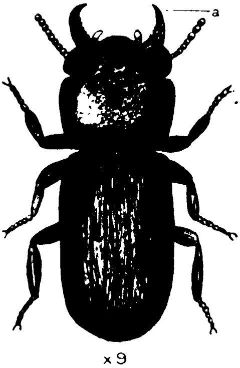

FIG. 68.—Flour Beetle (*Gnathocerus cornutus*), male, showing (*a*) mandibles. (After Patton.)

What are the habits of flour-beetles?

The larvæ of *Tribolium* flour-beetles (figs. 67 and 69) wander about in the flour by means of the three pairs of legs; they come to the surface of the flour to moult, and so larval skins are to be found on the surface of infested flour. The adults fly to and from their feeding grounds, which may be remnants of meal or flour left lying about, or exposed stores of these commodities. Mating occurs soon after the adults emerge from pupation, and the female lays her eggs in flour, cocoa, ginger, pepper, ground-nuts, or any similar foodstuffs. The

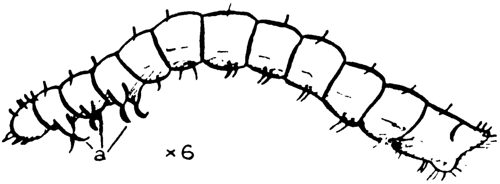

FIG. 69.—Larva of Flour Beetle (*Gnathocerus*) showing (*a*) three pairs of legs. (After Esdaile.)

sticky white minute eggs appear granular owing to adhering food. If given the opportunity these beetles can breed all the year round in places which are warm and evenly heated, such as a warm kitchen. The flour-beetle *Gnathocerus* usually lives where there is some animal material besides the flour or meal, and so it often lives in flour infested with the flour-moth larva of *Ephestia kuehniella* (*see* p. 169). The beetle feeds on the eggs, larvæ, and pupæ of the moth, and also on any damaged adults; it often uses the cocoon of the pupal moth in which to pupate.

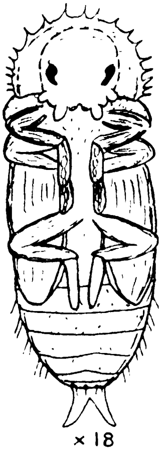

Fig. 70.—Pupa of Flour Beetle (*Tribolium confusum*).
(After Esdaile)

Life-history.

The eggs of *Tribolium* hatch in about a week if the temperature is about 60° F., into transparent larvæ which moult about six times. The length of the larval period depends on temperature and may be only a fortnight, but usually it is longer. The final larva is often a little more than ⅕ in. long before it crawls to a suitable place to pupate. The pupa (fig. 70) emerges as a pale-coloured adult in a very short time, at most a week, and the insect quickly becomes an opaque reddish-coloured flying creature. *Gnathocerus* lays her eggs singly, and because of their sticky nature they adhere to the foodstuff. If the temperature is about 70° F. they hatch in about a week into very active larvæ which, like *Tribolium*, moult six times, and often in this stage transfer their feeding from one foodstuff to another nearby. The pupal stage is longer than in *Tribolium* since it is often three weeks before the adult beetle emerges.

Simple remedies.

A small quantity of infested flour can be subjected to a temperature of about 185° F. in a hot oven. This destroys all stages of the beetle and does not harm the flour. The latter should be placed in shallow dishes about 2 in. deep while subjecting it to this treatment. If the foodstuff is badly infested it must be burnt, and the receptacle containing it very carefully washed; boiling water will reach into the corners and crevices of a receptacle and so kill any hidden pupæ.

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Beetles which Attack Cereals and Seeds

The Weevils

What are weevils?

The majority of small insects found in grain and cereals are called weevils, but this is not strictly correct since very few of them have the well-developed rostrum or beak at the front of the head which is characteristic of true weevils. Of the

20,000 kinds of true weevils only two infest cereals, although several are found occasionally in mace, nutmeg, coffee, ginger. Other beetles which feed on the pulses are often spoken of as the pulse or false weevils.

Kinds of weevils.

The two true weevils which enter the home are *Sitophilus* (*Calandra*) *granaria*, the granary or black weevil, and *Sitophilus* (*Calandra*) *oryzæ*, the rice weevil. Other occasional pests of the pantry are several of the pulse or false weevils, the commonest offenders being *Bruchus pisorum* or the pea weevil, *Bruchus obtectus* or the bean weevil, and *Bruchus lentis*, the beetle which attacks lentils, beans, and peas.

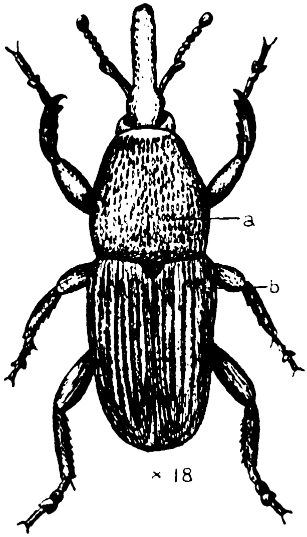

FIG. 71.—Adult Granary Weevil, showing (*a*) shallow depressions on thorax ; (*b*) punctures on elytra. (After Patton.)

Are the weevils serious pests?

Weevils are very destructive pests. Both the mature adults and larvæ live on grain, the former gnawing through the hard coat and so penetrating into the softer inside where adequate shelter and food is provided; the larvæ also live inside the kernel. Thus these creatures destroy much of the nutritive part of the cereals, and since they are prolific and can breed all the year round in well-heated rooms, the amount they consume and foul is alarming. The rejected tough skins of the grain and the larval skins and dead weevils all accumulate in infested grain and, if it is wheat, may ultimately be ground up and become flour.

During which part of its life is it a pest?

These beetles are pests during the whole of their life-history.

What do these weevils look like?

The granary weevil (*Sitophilus granaria*).—This beetle, $\frac{1}{8}$ in. long, is light brown in colour and has a long slender snout at the end of which is the mouth surrounded by two minute cutting jaws. The thorax is one and a half times the length of this snout and is covered irregularly with shallow depressions which give a pitted appearance. The elytra, with longitudinal rows of punctures, completely covers the oval-shaped abdomen (fig. 71). The second pair of wings, which are usually well developed in beetles, are very poorly developed (if at all), for this granary weevil does not fly but runs from place to place. The larva (fig. 72) is white and legless, has a short stumpy appearance, and usually reaches a length of $\frac{1}{15}$ in. before it pupates.

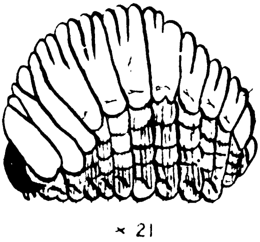
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FIG. 72.—Larva of Granary Weevil. (After Patton ; after Cotton.)

The rice weevil (*Sitophilus oryzæ*).—This weevil (fig. 73) is similar in most respects to the granary weevil, but differs in a few characteristics such as colour, wings, elytra. It is a light brown colour when it first emerges, but gradually gets a rich darker colour. The elytra have well-developed grooves with four characteristic brown marks; the second pair of wings are very well developed, and are used extensively in flight. The larva is also very similar to that of the granary weevil.

What are the habits of the weevils?

The granary weevil can live up to a year if supplied with plenty of food. At temperatures of 55° F. and lower it can reduce all activities, and can live up to two months without food; if subjected to a high temperature it dies. The adult can gnaw tiny holes in packages of cereals and also through the tough skin of the grain, and so get to the kernel for food and to deposit the eggs where the larvæ will hatch into a food supply. Since each larva is confined to one grain it is usually only the larger grains (e.g. wheat, barley) which are affected, as the smaller seeds would not provide sufficient food for the whole larval stage. The larva tunnels its way through the endosperm in a winding fashion, usually keeping fairly close to the skin of the grain at first. Although it does not live on such powdery material as flour it readily feeds on products like macaroni. As the creature eats its way through the grain (and the rate is determined by the amount of moisture present), powdered frass is left behind in the tunnels; this excrement

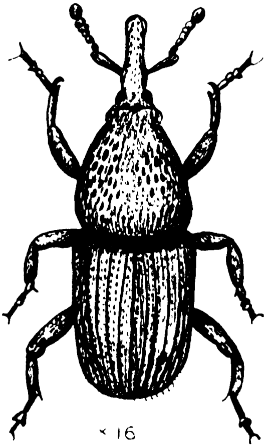

FIG. 73.—Adult Rice Weevil. (After Patton.)

fouls any nourishment left in the seed when the larval weevil pupates.

The rice weevil adult is a strong flier, especially at night, and since it attacks the growing plants much rice is infested before the grain is stored and packeted and long before the housewife buys it. As in the case of the granary weevil the eggs are placed singly in holes in the hard grain made by the adult's beak.

Life-history.

Development in both weevils is indirect because both pass through a resting pupal stage before the adult beetle emerges. The length of time which elapses in passing through all stages is determined largely by temperature conditions and in some degree by the moisture content of the grain. In a well-heated room breeding takes place all the year round, and the female adults are very prolific and continue to lay eggs for several months at temperatures between 60 and 65° F. The larvæ moult three times and then often rest in a pre-pupal condition for a short period, the length of which is dependent on temperature, before the white pupa evolves from the last larva. The pupa still remains within the seed where the egg was laid, and the adult on emerging crawls to new grain if it is a granary weevil or flies to infest new stores if it is a rice weevil.

How to prevent this pest.

The prevention of this pest is not in the hands of the housewife since usually she gets the pest into her home by unwittingly buying a packet of infested rice or pearl barley. If there is any evidence of adults, frass, or larval skins in cereals, she must destroy by burning the packet and its contents immediately in order to prevent infestation of other dried cereals. Then, too, it is wise to keep goods of this nature in a dry cool place since activities of any of the pests are reduced under such conditions.

The False or Pulse Weevils

Are the pulse weevils serious pests?

The larvæ of the pulse beetles live in the seeds of leguminous plants, sometimes when the plants are growing, but other larvæ attack the seeds when they are stored in the packets ready for purchase by the housewife. They do considerable damage to peas, beans, lentils, etc., and every housewife is familiar with the appearance of an infested pea with its shell enclosing a " grub," the larva of the " weevil."

What do pulse weevils look like?

The beetles are almost $\frac{1}{5}$ in. long, and are short and flat with the head prolonged into a long broad beak which makes it appear like the true weevil with its snout. The elytra are so short that they do not completely cover the abdomen. The common pea weevil (fig. 74) is brownish-grey with black and white mottled elytra, and the common bean weevil is similar but with less pronounced markings. The larvæ grow by a series of moults into white broad wrinkled grubs about $\frac{1}{4}$ in. long, with biting mouth parts; they are covered with small bristles and have three pairs of very short legs (fig. 75).

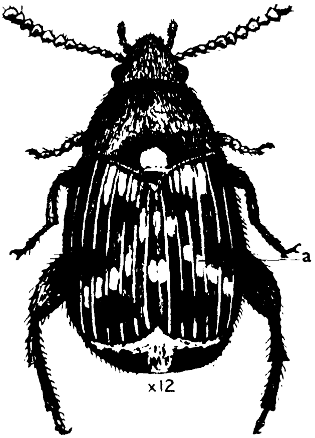

FIG. 74.—Common Pea Weevil, showing (*a*) short mottled elytra.

What are the habits of the pulse weevils?

The adult female pea weevils lay their eggs singly on the outside of the pods to which they are attached by a sticky substance. These minute eggs $\frac{1}{20}$ in. long hatch into the larvæ which can bore their way into the pod and so into the peas. Although only one larva attacks one pea, several larvæ may bore into one pod. The holes by which the larvæ enter the pod become sealed up and pupation takes place within the pea after much of the pea contents have been eaten by the larva. It is interesting that the larvæ avoid eating the minute pea-plant and devour the endosperm only, and as a consequence such peas will germinate. Some pulse weevils attack dried peas, the female laying her eggs on the outside of the dried covering, and the larva bores its way in.

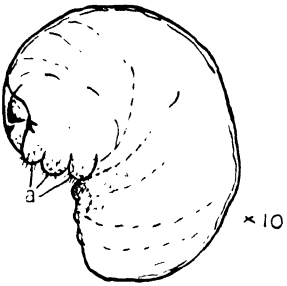

FIG. 75.—Larva of Pea Weevil (side view) showing (*a*) three pairs short legs. (After Esdaile.)

Life-history.

There is a complete metamorphosis in the life-history, and the pupa makes no case but relies on the seed-coat for protection. Usually the pea weevil produces only a single generation during one year, and the female adult is thought to hibernate during the winter in the peas.

How to prevent this pest.

This is hardly a matter for the housewife but rather for the storekeeper and warehouseman.

The Saw-toothed Grain-beetle

What is the saw-toothed beetle?

This beetle, *Orzœphilus* (*Silvanus*) *surinamensis*, is often referred to as the bran-bug or the saw-toothed weevil, and is found infesting the stores in a grocer's shop, and thus in the provisions purchased by the housewife.

Is the saw-toothed grain-beetle a serious pest?

This beetle not only feeds on grain but is an omnivorous eater, attacking dried fruit (especially raisins), sweets, flour, cereal foods, and so on; in fact, it likes nearly all dried provisions except sugar, starch, and dried meat. Thus it damages much food, especially that packed in paper packets. The tiny adult gains access to a commodity by boring a very small hole in the package, and the housewife thus could easily buy an infested packet since the hole is not easily noticed. Several beetles in a packet of food make it very unsightly and unpalatable. A great quantity of food is eaten both by the adult beetles and their larvæ, and much is fouled by the excreta and larval skins.

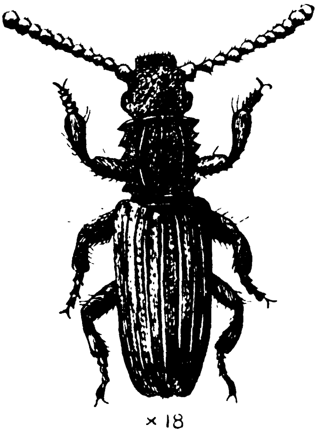

FIG. 76.—Adult Saw-Toothed Grain Beetle. (After Patton.)

During which part of its life is it a pest?

This beetle is a pest throughout the whole of its life.

What does a saw-toothed grain-beetle look like?

The adult is hardly $\frac{1}{10}$ in. long and has a narrow chocolate brown body rather flattened. There are about six tooth-like projections on each side of the thorax, and these are responsible for the popular name of this beetle. The whole body, including the wing-covers (elytra), has a pitted appearance due to innumerable punctures (fig. 76). The *head* has two fairly long feelers with somewhat swollen ends. The *thorax* has two wide sunken areas with a distinct longitudinal ridge running down the middle and this, together with the saw-like margins of this area, give the beetle a very characteristic appearance. The *abdomen* is completely covered with the elytra. The larva is a flattened, long, white, segmented creature, with a dark mark on the upper surface of each segment. It has several dark hairs, a pair of short feelers produced from the dark head, and three pairs of short walking legs.

What are the habits of the saw-toothed grain-beetle?

The adult bores its way through paper packages in its endeavour to find food and a breeding ground. The beetle seldom flies from place to place but wanders on its walking legs from food to food, since it has such catholic tastes. Often several beetles move about together, and if a tin or package of food is infested several of the minute insects are seen hurrying about at the bottom of a tin or bag after the contents have been emptied. These beetles are very prolific and the female lives for up to five months, during which time she is continually laying eggs. The larva does not make a protective case for the pupa if it is living in a fine substance like meal or flour, but if its habitat is a coarser substance the larva makes a case from fragments of food in which the pupa can be protected.

Life-history.

The female beetle lays her eggs in collections in any cracks in the receptacle where the food is stored; in the case of fine meal or flour the eggs are often laid singly, scattered in the food. The time elapsing before hatching depends on the temperature. A few eggs (up to eight) are laid daily for nearly five months, and the female begins to oviposit a few days after emergence from the pupa. The larva moults about three times and then crawls to a crevice to pupate. The length of time taken by all stages varies very much with the temperature and can vary from a month to nearly a year. In a warm, continually heated place, breeding continues throughout the year, so that all stages of this beetle may be found in the home at all times.

How to prevent this pest.

Since much infestation occurs before the housewife has purchased her goods, due to lack of supervision and cleanliness in the stores and warehouses, she must not buy in too-great quantities and must store provisions in a cool dry place. Cleanliness is all-important in keeping this pest in check.

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Metcalf and Flint	Destructive and Useful Insects.	A B C D E

KEY TO CONTENTS

A - Description of pest.
B - Description of life-history.
C - Effect of pest on man.
D - Methods of control.
E - Good illustrations.
* - if cost is under 1s. 6d.

BEETLES WHICH ATTACK HAM, MEAT, CHEESE

Larder Beetles (Dermestes lardarius)

What are larder beetles?

As the name implies, these beetles frequent the larder in order to lay their eggs on some meat, so that their larvæ will be provided with food. They are often spoken of as bacon or ham beetles since the larvæ are often found on this food.

Is the larder beetle a serious pest?

The larva of this beetle attacks meats principally, but failing these will eat cheese and beeswax in the home, and carcasses, hides, and skins elsewhere. They spoil the food with their tunnels, making it look repulsive, apart from the fact that the tunnels contain cast larval skins and excrement.

What harm is done?

The larder beetle spoils food by making it unpalatable, but since the larvæ feed on carcasses, hides, and skin, besides food in the larder, it has been suggested that they may be instrumental in carrying the disease-germs causing anthrax.

What does the larder beetle look like?

The adult, which is usually out of doors except when the female comes in to breed, is about ⅓ in. long with an oval black body covered with greyish-yellow scales on the front part of the wing-covers (fig. 77). The larva when fully grown is about ⅝ in. long, of a brown colour, and is covered with some long hairs and tufts of short hairs. There are also three pairs of short legs and two long sharp spines at the posterior end of the body (fig. 78).

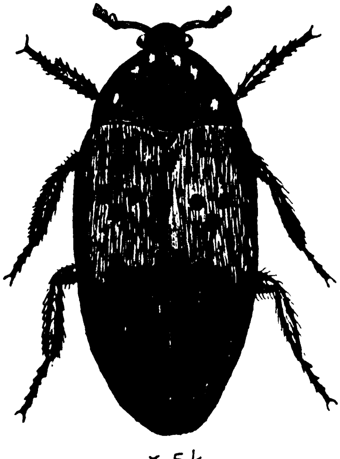

FIG. 77.—Adult Larder Beetle. (After Patton.)

What are the habits of the larder beetles?

The adult female tends to fly into the house in the months of May and June, having passed the winter months hibernating out of doors, probably under the bark of trees. The female lays her eggs on meat or cheese, usually in batches, in any crevices or cracks or on the underside of the food where it is in contact with the dish.

Life-history.

Eggs are laid throughout the summer. The larvæ, which hatch out in about twelve days, at first wander over the food, tending to confine themselves to the fat portion of ham or bacon. After eating and moulting a few times they begin to tunnel into the meat, and after the fifth moult pupate. The

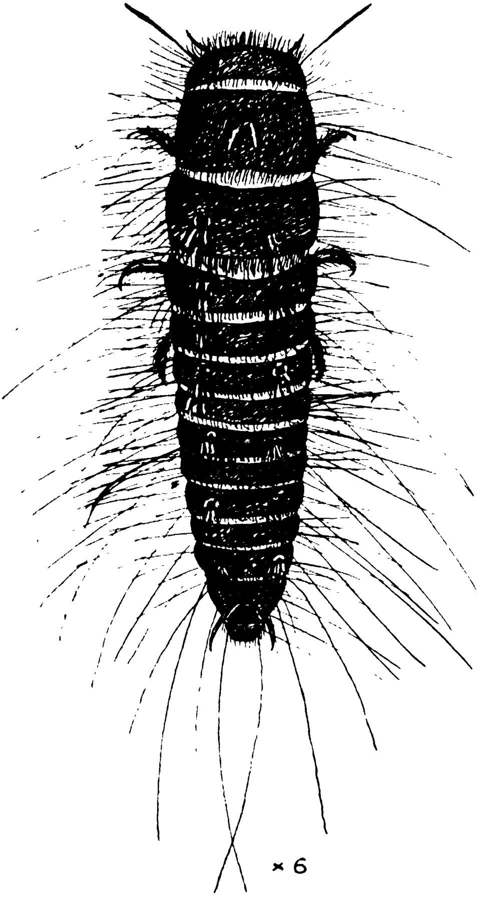

FIG. 78.—Larva of Larder Beetle. (After Patton.)

resting stage lasts approximately a week, but low temperatures prolong larval and pupal stages so that usually there is only one generation a year.

How to prevent this pest.

The obvious way to stop spoiling of food is to prevent the female laying her eggs on it. Thus all larder windows should be screened with fine gauze, and foods such as meat, ham, and cheese, should be put under gauze covers or in meat safes.

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Herrick.	Insects Injurious to the Household and Annoying to Man.	A B C D E
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Patton.	Insects, Ticks, Mites and Venomous Animals of Medical and Veterinary Importance, Pt. II.	A B C D E

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CHAPTER XVII

MOTHS

MOTHS, together with butterflies, belong to the group Lepidoptera, and are familiar insects to everyone since they are large compared with the majority of insects. They all have two pairs of well-developed wings, the varying colours of which are due to minute scales which cover both them and the body. The adult moths are nocturnal creatures. They do not feed, but may come into the house in order to breed. The larvæ produced by the latter constitute some of the most serious pests in the home. Some of the larger moths, usually seen flying about the house at dusk, are only temporary invaders and do no damage in the home. They come in through open windows when darkness falls, apparently attracted by the light. The destructive larvæ of moths which spend their life in the home attack clothing, furs, upholstered furniture, tapestry, carpets, feathers, skins, seeds, stored grain, flour. The principal offenders are those which eat wool and so are attracted to anything containing it, and are called *clothes-moths*. Other offenders are called *house-moths*, since the larvæ feed on stores and remnants of food, grain, and seeds, and on carpets and clothes. Several other grain-eating larvæ of moths are found wherever there is stored grain, but as this is usually outside the home they do not fall within the province of the housewife. All moths pass through a complete metamorphosis in their growth from egg to adult, and with the majority, in the resting stage immediately preceding the adult, there is a cocoon in which the pupa lives, called the chrysalis.

The clothes-moths and house-moths are some of the smallest moths seen, for the wing-span is usually under 1 in.; occasionally a female of one of the house-moths (the brown house-moth) may slightly exceed this. Movement in these moths is not always by means of the wings, especially in the females, which tend to run very quickly to a crevice if disturbed. The way the wings are carried when not in flight helps to distinguish the adult clothes-moth from the house-moth. In the former the wings lie very close to the body in a sloping fashion, whereas in the latter the wings cross over like scissor-blades with the tips not meeting.

CLOTHES-MOTHS (TINEIDÆ)

What are clothes-moths?

Clothes-moths are dull-coloured insects with two pairs of wings fringed with scales. These wings are so closely folded about the body when the insect is at rest or runs that the creature appears long and narrow. These moths are the bugbear of the housewife since the larvæ live on wool, and thus destroy clothing and any furnishings in the house which contain wool. They have been familiar pests for thousands of years and are referred to in the Bible (Book of Job).

Kinds of clothes-moths.

There are three kinds of clothes-moths which frequent the home: The *common clothes-moth* (*Tineola bisselliella*), sometimes called the webbing clothes-moth or the naked clothes-moth; the *case-bearing clothes-moth* (*Tinea pellionella*), sometimes called the fur moth or the single spotted clothes-moth; and the white-tip clothes-moth (*Trichophaga tapetzella*), sometimes called the *tapestry moth.* The first two are the commonest types of clothes-moths frequenting the home.

Are clothes-moths serious pests?

The larvæ of these moths feed voraciously on all woollen goods, furs, feathers, carpets, etc. The larva of the common clothes-moth principally attacks matter of animal origin, especially cloth and woollen clothing, furs, feathers, and upholstery, and occasionally it attacks grain. The case-bearing moth larva also lives on wool. The tapestry moth larva lives on coarse heavy fabrics like carpets, tapestries, felting.

What harm is done?

It is not the quantity of material that these moth larvæ consume that makes them such harmful pests, but the fact that the small holes in the fabric which result from their feeding may cause complete ruin to a whole carpet, garment, or tapestry. For instance, a valuable fur coat, suit, or dress, may be made entirely worthless by one small hole appearing in a prominent part of the garment. The common or webbing clothes-moth is usually the most abundant type in our homes, and therefore causes the most damage. Clothing and household materials in weekly use, or articles brushed and cleaned and beaten monthly, are not harmed by this pest, but furniture may be in constant use and still be infested. This is because so many furniture makers neglect to put a layer of cotton between the pile and the stuffing, so that if eggs are laid on the pile the larvæ hatching from them will eat their way into the stuffing of the chair, which a housewife cannot reach in her weekly cleaning.

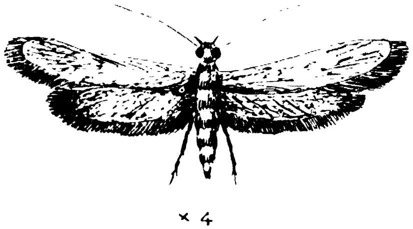

FIG. 79—Common (Webbing) Clothes-Moth, female. (After Esdaile.)

During which part of its life is it a pest?

Any of the three kinds of clothes-moths are pests during their larval life. This is the time when they are growing and getting food at the expense of the housewife's possessions. Each larva or grub eats its way along in the clothing, fur, or whatever material in which it finds itself. Periodically it moults and increases in size until the quiescent stage is reached, when it ceases to do harm.

What does a clothes-moth look like?

The *common or webbing clothes-moth* is uniformly pale buff in colour with unspotted wings, rather like tussore silk. The female (fig. 79) has a wing-span of about ½ in. which is slightly larger than that of the male. The size of the moths varies slightly, depending on the type of food available during the larval stage.

The *case-bearing moth or case-making moth* is about the same size as the former but has characteristic wings. The first pair are pale brown with indistinct dark spots, and the second pair are lighter in colour with a silky appearance (fig. 80).

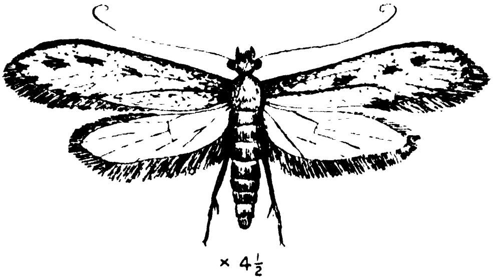

FIG. 80. —Case-bearing (Case-making) Clothes-Moth, female. (After Esdaile.)

The *tapestry moth or white-tip clothes-moth* is fairly large with a wing-span of just over ¾ in. (fig. 81). It has a white head region and whitish yellow fore-wings with the part nearest the body a dark mottled brown; the hindwings are pale grey. When the wings are folded over the abdomen the forewings give a banded appearance, as if the creature were wearing a dark cape.

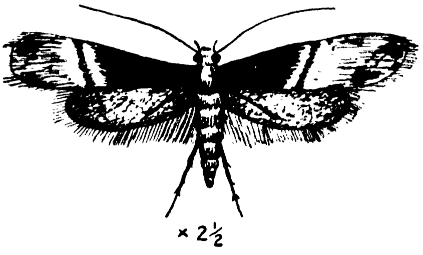

FIG. 81. —Tapestry (white tipped) Clothes-Moth, female. (After Esdaile.)

Habits of clothes-moths.

The adults tend to be active at night when the males fly in search of females, which are usually lurking in a breeding place, and if disturbed run rather than fly to a nearby crevice. Thus a moth caught on the wing is usually a male. Egg-laying females are seldom seen unless disturbed in their breeding places, such as a wardrobe or drawer. Temperature has a great effect on activities, especially breeding, all temperatures above about 65° F. conducing to activity. With the growing installation of central heating and hot-water systems, there are certain places in the home where the temperature is maintained at or above 65° F. all the year round, so that if goods containing wool are stored in the vicinity of these warm places breeding of moths may continue all the year round unless special precautions are taken. This continual activity means that in some homes moths are seen on the wing at any time of the year. Usually, however, spring and autumn are the periods when adult males are seen flying about the house, and females lurking in cupboards, but this seasonal appearance is governed to some extent by the length of larval life, which tends to vary according to variations of temperature, and insufficient or unsuitable food. The adults do not take in any food but are merely concerned with reproduction. As soon as they are liberated from the quiescent or pupal stage, mating occurs and the female proceeds to lay her eggs. The eggs of the common clothes-moth are laid in batches of from six to eight during the first two weeks of the female's life, after which she dies. In spite of this short adult life she may have laid up to 160 eggs, dependent on temperature. These eggs are placed on material suitable as food for the future larvæ, and a secretion is passed out with the eggs by the female to attach them to the fabric and prevent them falling off.

Life-history.

(*a*) *The common clothes-moth.* The life-cycle from egg to adult moth passes through four distinct stages (egg, larva, pupa, moth), and the time taken for the complete indirect development is determined by several factors such as temperature, suitable food, humidity, aptitude for the larva to stop feeding periodically and become quiescent. Many larvæ which hatch during the summer months do not become mature moths until the following spring, having spent the winter eating and resting. Their progeny in turn are the moths seen on the wing in late summer and early autumn. The long oval pale ivory coloured eggs are about $\frac{1}{24}$ in. long and hatch in about a week at ordinary room temperature, but hatching is quicker in hot summer weather. The grubs or young larvæ immediately begin eating and small white worm-like creatures crawl over the fabric, often leaving behind some transparent silky tubes on the surface. The tubes are often fifteen times the length of the larva and are made from the fibres of the fabric. The grub can eat from either end of the tube, and occasionally a larva may leave its silken tube when it moves to a new feeding place, or it may continue to add to the length of the existing tube. If the larva is infesting a fabric with pile, it burrows down to the foundation warp which it destroys, so that the pile drops off. The larva moults several times, dependent on the length of time spent in the larval state and on the type of food available.

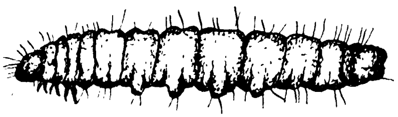

FIG. 82.—Full-grown larva of Common Clothes-Moth. (After Patton.)

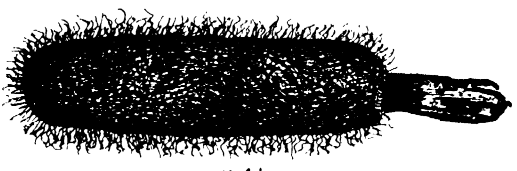

FIG. 83.—Cocoon of Common Clothes-Moth, with pupal case protruding.

The grub on hatching is only $\frac{1}{25}$ in. long; it has three pairs of legs and four abdominal false legs, and feeds and moults sometimes seventeen times until it is almost $\frac{1}{2}$ in. long (fig. 82). This period of growth may take up to four years, as often a grub will stop feeding and become quite inactive, only resuming activity and feeding if disturbed. This starvation has no effect on the reproductive powers of the final adult, but may account for a smaller size. The fully grown larva ultimately forms a silken cocoon by using fibres from the material on which it is feeding and some of its excrement. Within the cocoon the larval structure becomes reorganized and a resting pupa or chrysalis results which, sooner or later, according to conditions of temperature and humidity, gives rise to the adult. This flies away, leaving the pupal case protruding from the cocoon (fig. 83). Occasionally pupation is delayed even after the cocoon is formed, so prolonging the larval stage. The length of a life-cycle may therefore vary from about fifty-five days to as long as four years.

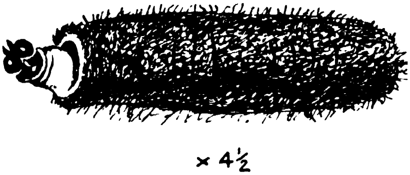

FIG. 84.—Larva of Case-bearing Clothes-Moth in case.

(*b*) *The case-bearing moth.* The life-history of this moth is similar to that of the webbing or common clothes-moth. The principal difference is that the larva of this moth makes a closely woven portable case lined with silk and covered with material from the fabric on which it feeds. The case finally attains a length of about ⅜ in. although it is originally much smaller, for it is enlarged to accommodate the growth and moulting of the larva. The larva never leaves its case, not even during moulting, nor when it makes its case larger (figs. 84 and 85). The case is carried about and the larva merely protrudes its head and thorax, which has three pairs of walking legs. When disturbed, the larva retreats completely into the cylindrical, slightly flattened case. Occasionally

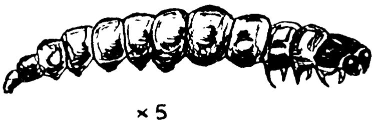

FIG. 85.—Larva of Case-bearing Clothes-Moth, removed from case.

this white larva with its dark shining head is found crawling over wallpaper, and it is thought that failing the usual diet of wool it gets its sustenance from the paper or paste. Sometimes this larva becomes quiescent, but never for such long periods as the larva of the common clothes-moth. Pupation occurs in the larval case when the grub is fully grown. The adult ultimately flies away, leaving an empty case with the pupal skin protruding (fig. 86). This may occasionally be found in clothing or even on wallpaper. Usually mating and ovipositing of the adults occurs in the summer months, the cold weather being passed in the quiescent pupal stage. Factors such as temperature modify the time of emergence of the adult, and in warm localities there may be three generations in one year.

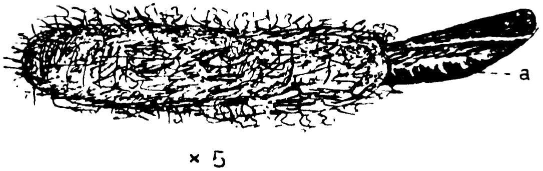

FIG. 86.—Larval case of Case-bearing Clothes-Moth, with (*a*) pupal skin protruding.

(*c*) *The tapestry moth.* The female adults (fig. 81) lay their eggs any time from April to June, and the larvæ hatch and burrow into the material on which they live, usually carpets, furs, and skins. These larvæ make silk-lined burrows in all directions in the coarse fabric, and thus cause much more damage than that resulting from the actual feeding activities. Sooner or later pupation occurs and a cocoon is made. The adults liberated during the summer months produce larvæ which pass the winter in a prolonged larval state, eating the coarse fabric and passing into a state of pupation and finally appearing as adults in the early spring of the following year.

HOUSE-MOTHS

Kinds of house-moths.

There are two kinds of house-moths which are pests in the home, viz., the white-shouldered moth (*Endrosia lactella*), and the brown house-moth or false clothes-moth (*Borkhausenia* *pseudospretella*). Both fold their wings scissor-fashion, with the tips not quite meeting, when resting or running.

Are house-moths serious pests?

The brown house-moth is a serious pest in most homes, for the larvæ attack so many substances in search of food. At one time they were considered to be vegetarians living principally on stored grain and seeds, but it is now known that they are equally well attracted to materials of animal origin and live in carpets and woollen clothing. There is little doubt that the brown house-(false clothes) moth is on the increase in our homes, and is probably the commonest of all the moth pests whose larvæ injure household goods of practically all kinds.

The white-shouldered moth is not a pest of any importance since the food it likes (grains and seeds) is not usually stored in the house.

What harm is done?

The white-shouldered moth larva ruins stores of seeds. The brown house-moth larva seriously harms many things including cloth bindings of books, seeds, flour, corks, carpets, furs, skins, and clothes. As more knowledge about the pest accumulates it is found to be responsible for damage to a steadily increasing number of household things.

During which part of its life is it a pest?

Both kinds of house-moths are pests during the time when they are larvæ. The grub-like creatures live on the housewife's goods at the expense of which they gradually increase in size until they become quiescent harmless pupæ.

What does a house-moth look like?

The white-shouldered moth has a characteristic white head and thorax and greyish-yellow wings, the second pair of which are fringed with yellow scales. The male has a wing-span of about $\frac{1}{2}$ in. and the female almost $\frac{3}{4}$ in. When not flying the moths fold their wings, and the female then measures $\frac{5}{12}$ in. in length (fig. 87). The fully grown larva is about $\frac{1}{2}$ in. long and dirty white in colour with a dark brown head.

The brown house-(false clothes) moth has dark brown forewings, each with two dark spots, whitish-grey hind wings, and a head light-brown in colour. It is a fairly large variety, for the female has a wing-span often more than 1 in. and the male a span of about $\frac{3}{4}$ in. When the female is resting it has a body length of almost $\frac{7}{12}$ in. (fig. 88).

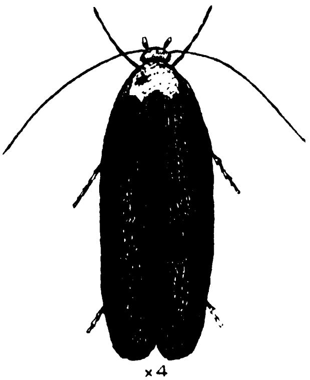

FIG. 87.—White-shouldered House-Moth (female) at rest.

What are the habits of the house-moth?

The adult white-shouldered moth is usually seen during the summer months, for the winter is passed in the larval and pupal stages. Occasionally drowned adults are seen in milk and other liquids. The larvæ of this moth are vegetable feeders and are to be found at all seasons among seeds, straw thatch, and dry vegetable refuse.

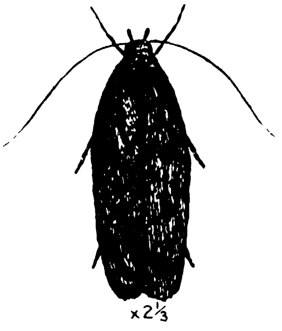

FIG. 88.—Brown House-Moth (female) at rest.

The adult brown house-moth is seen about the house in the warm summer months, and also may be found on the wing in our gardens on warm evenings. In centrally heated buildings, however, where the temperature is high, the adults may be seen at any time of the year, the males flying and the females laying eggs. The larvæ are omnivorous feeders, and may be anywhere in the home, for instance along the free edges of linoleum and carpets where remnants of food and fluff collect, in the binding of books, in the stuffing of upholstered furniture, in furs and skins, and amongst clothing.

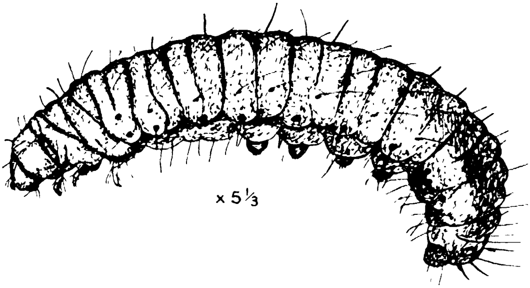

FIG. 89.—Full-grown larva of Brown House-Moth. (After Patton.)

Life-history.

The life-history of the white-shouldered moth is not very well known, but the larva is recognizable as a dull white grub about ½ in. long, covered with a few yellow hairs.

The larva of the brown house-moth is about ¾ in. long just before it pupates. It is very pale yellow in colour, is covered with a few yellow hairs, and has a reddish-brown head. It has three pairs of walking legs and four pairs of false legs by means of which it moves (fig. 89). When the fully grown larva pupates it makes a cocoon from the material upon which it has been living. The length of time which elapses both in the larval and pupal stages varies largely with temperature, but the average length of the life-cycle seems to be about eleven months.

How to prevent clothes-moths and house-moths.

Clothes- and house-moths which breed in clothing and furnishings only do so in those goods not in regular use but packed away loosely in drawers, boxes, and wardrobes for storage. All goods containing any wool should be well beaten, brushed, and hung out in the air and sun before being put away. This removes any eggs, larvæ, pupæ, or adult moths. If there is no sun, it is advisable to hang as many things as conveniently possible near a hot fire, the heat from which destroys any eggs which have escaped brushing. Soiled goods should be well cleaned since the larvæ seem to prefer soiled spots as food. These goods must then immediately be packed away in such a manner that no female moth has access to any part of the woollen material. If possible the goods must be stored in a cool place. Garment bags of cotton, stout paper, manilla, which can be absolutely sealed, are suitable for hanging clothes; clothing and furnishings well wrapped in paper with all edges sealed can be safely stored in drawers and cardboard boxes; wooden boxes with tight-fitting lids are suitable for blankets and large goods, but even these should be placed in a stout cotton envelope and the opening effectively closed.

It is advisable to supplement this mechanical protection by a chemical repellent. In all the above receptacles naphthalene or paradichlorbenzene should be placed either in muslin bags or scattered loosely; the fumes from these volatile substances not only repel any moths but prevent any eggs, which escaped removal during the brushing and cleaning of the goods, from hatching, and destroy any larvæ. To prevent moths breeding in upholstered furniture is a more difficult matter since infestation often occurs in the upholstery before the final cover is put on and before the furniture is received in the home. Though this furniture may be in daily use and be constantly cleaned the larvæ are thriving within on the woollen stuffing, and may become so numerous that they penetrate to the cover, to the housewife's surprise and consternation. Nowadays wool is not so commonly used in upholstery work and makers are more careful on the whole; where woollen coverings are used the housewife should insist on a cotton lining cover before the final cover is attached. If loose covers are used they must be regularly removed for washing, and the fixed covers must be well brushed or treated with a vacuum cleaner. Rugs, carpets, and heavy curtains, besides being regularly brushed or cleaned with a vacuum cleaner, should have particular attention paid to those parts such as edges of carpets, the pleated top common in curtains, etc. Rugs and carpets should not be left folded up and packed away for a long time unless very well wrapped up in a thick brown paper package containing a repellent. All cracks which might harbour fluff, dust, or remnants of food, must be filled in, and those which are unavoidable should have particular regular care paid to them in the cleaning of the house. No stores of grain or seeds should be left exposed either in the house or in nearby outhouses, since some species breed in these places.

Simple remedies.

Fumigation is one means of checking these moths, and an effective fumigant which can be safely used by the housewife is the vapour or gas given off by paradichlorbenzene. It is most important to use enough of this white crystalline substance so that the fumes given off will be sufficient to destroy the moth. If present in sufficiently large quantities the fumes prove toxic to all stages in the life-history of moths. Therefore it is most important not only to estimate the space taken up by a moth-infested article, but also to confine the fumes to this space. Small amounts of fumes of the toxic vapour act as splendid repellents against moths but to destroy, the fumes should be of a standard concentration. Thus it is no good scattering the crystalline powder on open shelves, but the infested article must be placed in as enclosed, airtight, and draughtless a place as possible to confine the fumes. The attainment of a lethal concentration is not easy in dealing with all moth-infested articles. Infested clothing or blankets can best be treated in an airtight box, but a moth-infested upholstered chair presents a much more difficult problem. A boxroom where moths are breeding is best dealt with by sealing up with the fumigant for several days. Paradichlorbenzene volatilizes in a closed space according to the temperature, and high temperatures such as 60° F. or above, render the fumigant more effective against any adult moths, their larvæ, pupæ, or eggs. Some typical methods of application are as follows:—

The amount of paradichlorbenzene necessary to disinfect clothing in a box 3 ft. by 2 ft. by 2 ft. is 1 oz., which should be scattered throughout the clothing. After several days' exposure the clothing should be well brushed and aired, and stored as previously described. Larger boxes require a proportionately larger amount of fumigant.

An infested boxroom can be treated by using paradichlorbenzene at the rate of 6 oz. for every 100 cu. ft. of space. The crystals should be scattered thinly on the highest shelves or hung in numerous muslin bags from the ceiling. Height is important since the vapour is heavy and only rises with difficulty. All windows, doors, and ventilators, must be carefully sealed, and the room left sealed for at least two days. On opening, the room and contents should be thoroughly cleaned and well ventilated, and any woollen goods packed away with some paradichlorbenzene as a deterrent.

In dealing with a moth-infested upholstered chair, the fumigant can be confined to the chair only by putting it in a draughtless room and covering it completely with a dust sheet which reaches to the floor all round. The space thus enclosed is estimated, and paradichlorbenzene used at the rate of 4 oz. for every 5 cu. ft. This should be scattered over the surface, and in addition small muslin bags containing the fumigant should be inserted down the seat at frequent intervals. After remaining covered for some days, the chair should be well brushed and thoroughly aired before use.

Similarly, a few muslin bags, each with about 1 oz. paradichlorbenzene suspended in a wardrobe or clothes container, or put inside the ends of drawers, will destroy moths at any stage of their life-history.

Before carpets are rolled and wrapped in paper for storage they should have paradichlorbenzene (about 2 oz. to 100 sq. ft.) scattered on them, for even after long beating a few eggs may remain in a thick pile carpet, and the fumes will prevent these from hatching.

Naphthalene can be used instead of paradichlorbenzene, but although it is less expensive much more has to be used to be effective. It is said that 1 lb. of naphthalene is equivalent to about ½ oz. of paradichlorbenzene, so that the use of the latter is to be recommended. Neither is harmful to man although the fumes tend to be unpleasant, and if inhaled in too great quantities are sickly and produce headaches.

Camphor and pyrethrum powder can be used, but the fumes from these are not very effective, and at best are merely deterrents. The same is true of cedarwood products, such as sprays, chips, and shavings, which do not destroy moths but merely repel them. Too much reliance must therefore not be placed in the use of cedarwood boxes to store woollen goods. Though the volatile oil from the wood repels moths, it would not destroy larvæ or eggs in infested goods.

It is possible to kill all stages of moths by subjecting infested material to a very high temperature, but, apart from exposing fairly small things to a hot fire for some time, heat is not a practical remedy for a housewife.

If it is known that turpentine will not stain material a contact poison like turpentine can be distributed by a sprayer and will kill all stages of moths.

Infested woollen goods can be cleaned by immersing them in water at a temperature of 140° F. for at least ten seconds, but of course many woollen things would be rendered worthless by this process. Then, too, clothing washed with a strong solution of neutral soap like castile soap will be freed from any moth larvæ, eggs, or pupæ, but again the fabrics might easily be ruined by this treatment.

Since some moth larvæ live in dust and fluff in floor crevices the best way to control them is to fill in as many cracks as possible, and in those that do exist apply paraffin occasionally with a steel knitting needle. Great care must be taken, however, because of the inflammable nature of paraffin. A better way is to resort to fumigation of the whole room with fumes of burning sulphur, which penetrate everywhere. Burn at least 2 lb. sulphur in a room 12 ft. square. Take care to seal all outlets to the room, and remove all metal fitments because of tarnishing. It must be remembered that fabrics and wallpaper will probably be bleached by the fumes.

What to do in a serious infestation.

Fumigants such as carbon tetrachloride or hydrocyanic acid gas are very effective in dealing with a very serious infestation, but these fumigants must be used by experts only, and the housewife must take advice from the local sanitary authority.

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MOTHS WHICH ATTACK FOODSTUFFS

The Flour-moth (*Ephestia kuehniella*)

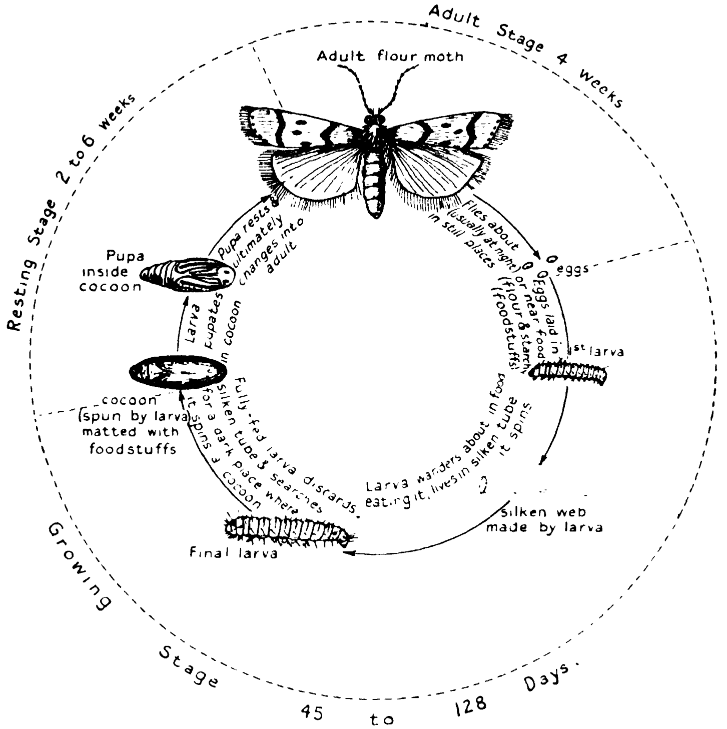
Adult Stage 4 weeks
Adult flour moth
Flies about (usually at night) in still places
eggs
Eggs laid in or near food (flour & starchy foodstuffs)
1st larva
Larva wanders about in food eating it, lives in silken tube it spins
Silken web made by larva
Final larva
Fully-fed larva discards silken tube & searches for a dark place where it spins a cocoon
cocoon (spun by larva) matted with foodstuffs
Larva pupates in cocoon
Pupa inside cocoon
Pupa rests & ultimately changes into adult
Resting Stage 2 to 6 weeks
Growing Stage 45 to 128 Days.

FIG. 90.—Diagram of life-cycle of Flour-Moth. (Not to scale.)

The larvæ of certain kinds of moths attack some of the housewife's stores of food, especially cereals and flour. Two which are found occasionally in English homes are *Pyralis farinalis*, the meal snout-moth, and *Ephestia kuehniella*, the Mediterranean flour-moth. The larvæ of the former are very seldom seen in their favourite breeding ground in the home which is amongst seeds or bulbs stored in damp cellars; if present several of them live together in long silken tubes. The larvæ of *Ephestia kuehniella*, the flour-moth, are frequently found in English homes amongst all kinds of flour and meal.

Is the flour-moth a serious pest?

The larvæ of this moth is not such a common pest in homes as it is in warehouses. It feeds on any kind of flour but may attack almost any dry foods such as biscuits, nuts, dried vegetables, powders, etc.; it also attacks grain which has previously been damaged by beetles.

What harm is done?

The larva makes a silken tube which it leaves as " webbing " in the floor. The presence of this vacated webbing is the chief indication of infestation and probably means that considerable flour has been fouled apart from that actually consumed. If a biscuit is infected with the " worm " and webbing it is most repulsive. Occasionally biscuits may become " worm-ridden " if left exposed in a draughtless place previous to packing in tins. Should a female moth then lay her minute eggs on these biscuits undetected, the eggs may hatch and the larvæ live on the biscuits whilst they are packed in the tins.

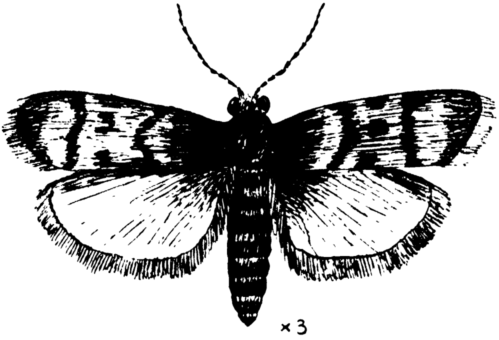

FIG. 91.—Adult Flour-Moth. (After Esdaile.)

What does a flour-moth look like?

The adult moth (fig. 91) has a wing-span of nearly 1 in., and when at rest the body measures nearly ¾ in. The colour is pale grey, with the front wings dark grey with a few dark spots and scales. The hindwings are silver in colour and both pairs of wings are fringed with hairs.

What are the habits of the flour-moth?

The adults fly about at any time but particularly at night; if disturbed during the day they fly away in a zigzag flight. They avoid draughty places. Adults do not feed and they only live for about four weeks. They quickly mate after emerging from the pupa, and the female proceeds to lay her eggs on some food suitable for the future larvæ.

Life-history.

Development is indirect, for the minute eggs hatch into larvæ which moult several times and grow at the expense of human food, usually flour and starchy foods. Each larva spins a silken tube as it moves about in the flour, biscuits, etc., and it is the accumulation of these tubes matted with food particles and larval excrement that renders such infested foods unsuitable for human consumption. The fully-grown larva (fig. 92) pupates and ultimately the pupa emerges as a moth. The length of time taken by these stages varies according to temperature, and in very warm places several generations may appear in one year. The pinkish-white coloured larva with its three pairs of brown true legs has also several pairs of little false legs, and the body has some bristle-like hairs. When fully grown the larva moves away from the flour in search of a sheltered place, such as at the corners or lid of the receptacle in which the flour is stored (*see* fig. 90). Sometimes a cocoon matted with flour is made, but occasionally the larva leaves the food entirely and crawls out of the receptacle to some nearby crevice where it becomes a pupa and does not form a special pupal case. This stage may last from two to six weeks.

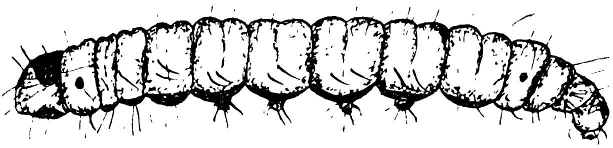

FIG. 92.—Full-grown larva of Flour-Moth (side view) much enlarged. (After Patton, after Candura.)

How to prevent this pest.

It is difficult to prevent this pest from entering the home from time to time since it is so common in warehouses, and therefore eggs, larvæ, and pupæ, easily enter on purchased goods. Flour, oatmeal, etc., should not be bought in too great quantities by the housewife, and all stores should be kept in light airy places through which a current of air is constantly passing since the adult moth dislikes light and breeze. Strict cleanliness should be observed in prevention of this pest. If the adult moths gain entry then the females must be prevented from breeding, and to do this flour and dry goods must not be left exposed.

Simple remedies.

If a sack of flour has the contents webbed together by strands of silken thread, or if any small container full of flour or meal has the web in it, then such infested material should be burnt. The sack also should be burnt, and any tin or pot container should be very well washed. Mildly infested flour can be made fit for use by subjecting it to a temperature of 140° F. for a short time. This is best done by exposing it in shallow tins in a hot oven.

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CHAPTER XVIII

THE EARWIG (*FORFICULA AURICULARIA*)

What are earwigs?

Earwigs are insects which have some long forcep-like structures at the end of the body, varying in size in the different kinds of earwigs. There is no evidence to support the belief that earwigs crawl into the human ear; they are no more apt to do this than any other insect.

Kinds of earwigs.

There are not many kinds of earwigs and only one, the common variety, gets into the house.

Is the earwig a serious pest?

The earwig comes into the home accidentally for no special purpose. It comes in on vegetables and flowers and occasionally from infested plants growing near windows.

What harm is done?

No serious harm is done to man or his possessions. Excreta is left wherever it wanders and floral decorations are spoilt by the insect biting the flowers.

What are the habits of earwigs?

The earwig usually wanders over plants, especially in the recesses of flowers, which it tears with the biting mouth parts. It is a very clean creature and regularly removes from its body any extraneous matter picked up during its wanderings.

What does an earwig look like?

This insect, with a body about ½ in. long, is dark brown in colour with a reddish head (fig. 93). The *head* has a pair of long feelers and dorsally is covered with a shield which overlaps part of the thorax. The *thorax* has three pairs of walking legs and two pairs of wings, the first pair of which are horny and act as covers to the delicate second pair when the earwig is at rest. Both wings are very short and do not cover the back of the abdomen. At the end of the abdomen there is a pair of peculiar toothed forcep-like structures. These are strong stout curved organs yellowish-brown in colour and very highly polished; the serrations are black. These structures, which vary in shape in the two sexes, distinguish an earwig from all other insects.

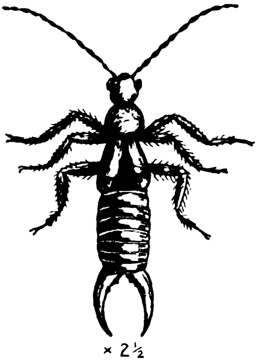

FIG. 93.—Earwig with wing cases slightly opened.

Life-history.

The earwig has a direct life-history and the larva and nymphs become more like the adult at each moult.

How to prevent this pest.

Care must be taken not to bring it into the house on flowers or vegetables. Creepers up walls should be trimmed well clear of windows and doors.

A simple remedy.

If an infestation occurs pyrethrum or carbolic powder should be scattered on floor and window-ledges.

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* If cost is under 1s. 6d.

CHAPTER XIX

WASPS AND ANTS

THE Hymenoptera group includes many well-known insects such as ants, bees, and wasps. Many of the varieties live in communities where there is remarkable division of labour; usually there are structural differences according to the work done. For instance, in ants there are the queens which lay eggs, the sterile females or workers which collect food and build the nest, the males which fly and pair with the queen in her early flying days.

Several kinds of insects belonging to the Hymenoptera invade the home either accidentally or for a purpose; some stay only a short time, but others become permanent inhabitants. The wood-wasps, honey-bees, bumble-bees, all enter the home accidentally and are not pests. The common wasps are temporary invaders of the kitchen in warm summer and autumn days, and may be regarded as serious pests. Ants, the social insects *par excellence*, live in their formicaries (nests) sometimes in very close proximity to the house, for certain kinds of ants enter the home temporarily to steal the housewife's provisions.

WASPS

What are wasps?

Wasps are large insects having well-developed wings for flying, and an apparatus for stinging. There are many varieties of wasps, the majority of which are social in habit, living together in nests.

Kinds of wasps.

The wood-wasps with their conspicuous black and yellow colouring only accidentally come into the house and do no harm. Many of the social wasps, or yellow-jackets, belonging to the variety Vespa, invade the home for the purpose of getting food. There are at least six species of Vespa, including the hornet, which are seen in the house. These wasps are classified into two groups according to the colouring of the feelers and thorax.

Are wasps serious pests?

Since wasps are omnivorous feeders and will visit refuse heaps, food in the home, garbage, and even fæces in their search for nourishment, they are serious pests. The structure of the body, with hairs covering both it and the three pairs of walking legs, make it a carrier of filth to our food.

What harm is done?

It is possible that the common wasp which frequents so many places in its search for food is instrumental in carrying disease-germs to human food and utensils. In their liking for fruit, wasps do considerable damage to ripening fruit. Moreover, their power of stinging may prove dangerous. To their credit is the fact that they attack certain household pests such as flies, but the relatively few adult flies that they destroy scarcely warrants their preservation.

During which part of its life is it a pest?

The queen wasp is a pest just after it wakes up from its winter sleep and has to search for its own food. The workers, produced by the queen, are pests during their adult life when they are obtaining food not only for themselves, but also for the queen and her young offspring.

What does a wasp look like?

The common wasp (*Vespa vulgaris*), which is the most frequent invader of our homes, has distinctive yellow and black stripes around the body, and is distinct from any other insect with yellow bands by its four wings (fig. 94), the anterior pair being folded longitudinally when the insect is at rest. Several other varieties of wasps, for example the German and the red-legged wasp and the hornet, invade the home. These are very similar to the common wasp except that the hornet is larger and is coloured brown and yellow. In a community of wasps there are three kinds, viz. the queen, the worker, and the male. The queen is the largest of the three types and is a fertile female which lays all the eggs and is responsible for establishing the community. The workers are smaller than the queen, are her first progeny, and are all sterile females. The males, which are produced by the queen in the late summer, have longer and narrower bodies than the other two kinds, and have slightly longer feelers. The females which are produced late in the season, unlike the workers, are fertile and are the potential queens of the next season. They have larger bodies than the sterile females (workers) produced during the earlier months. All the females, whether queens or workers, have their ovipositors modified as stinging organs.

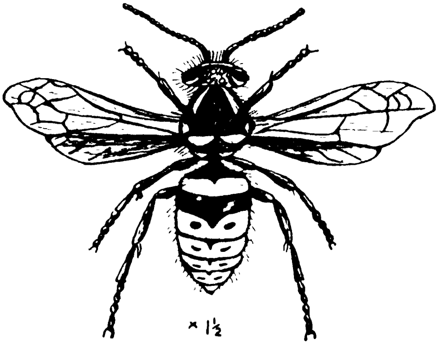

FIG. 94.—A Queen Common Wasp.

What are the habits of wasps?

Wasps are very susceptible to low temperature, and cold quickly numbs them, so that at the coming of the autumn frosts the workers and the males die, and a few females shelter in some hidden place during the winter months. If the hibernating females are able to withstand the rigours of winter and are not molested, they resume activity in the following spring. Each fertile female, having paired with a male the previous autumn, begins to make a nest during the warm spring days where she can deposit her eggs. Usually a hole is selected, but failing this the female makes one with her powerful jaws. She usually selects a hollow tree, a space under the tiles of a roof, or some other sheltered place in close proximity to the home. She collects woody fibres from old fences and works this material with her jaws into a pulp with some secretion she pours from her mouth. The greyish material which results is used to make a nest, and on hardening it assumes the appearance and texture of papier maché. The nest consists of hundreds of cells and is completely enclosed in the papier maché material, which gives only one outlet. Often as many as 20,000 wasps can live in one nest. The common wasp (*Vespa vulgaris*) and the German wasp (*Vespa germanica*), which are usually seen searching for food in English homes, very often use deserted mouse-holes in which to establish their nests. As soon as a few cells of the nest are completed the female (queen) lays some eggs, and these quickly hatch into sticky grub-like creatures which stick to the walls of the cells. The queen collects food (e.g. a fly) to feed these grubs, which rapidly increase in size; the queen enlarges the cells to accommodate their growth. Pupation follows in the cell, the open end of which is covered for the purpose by a silken cover made by the fully grown larva. The pupa quickly emerges as a worker wasp which takes its share in nest enlargement and the feeding of more young produced by the queen. The first batch of workers are usually on the wing early in July, and very soon afterwards they commence searching for food and material to increase the size of the nest. They devote all their energies to enlarging the nest by increasing the size of existing cells and making new ones, and to fetching food to feed the ever-increasing number of larvæ and the queen, which remains within the nest and devotes herself to egg-laying during the summer. Towards the end of the warm season eggs hatch out into both males and females. The former, after mating with the latter die, but the females seek a hiding-place for the winter. The queen which made the nest, together with any workers, also dies at the end of the summer. Only the fertile females, the potential queens, endeavour to keep alive until the following spring. Other insects frequently live in a wasps' nest, preying on the wasp grubs, or eating debris of food.

Life-history.

The time elapsing between the laying of the eggs by the queen and the emergence of the adult wasps is just less than a month. The queen wasp puts each egg into a separate cell, whence the footless grub emerges and passes its time eating food and moulting, until finally it closes the opening of the cell by a woven silken cap. In the sealed chamber it becomes a quiescent pupa, and in a few days the metamorphosis is complete and the adult wasp emerges. In early summer all the wasps are females and workers, but in the late summer some males, as well as females, are produced. The males pair and die, but the potential queens seek out a sheltered nook in which to pass the cold winter months.

How to prevent this pest.

It is impossible to keep all wasps out of the house, especially if a nest is near by. If a nest is suspected it should be traced and destroyed. This destruction, which should be done after dusk when all the workers have returned to the nest for the night is, however, not a matter for the housewife.

She can prevent the pest to a great extent by destroying the few wasps which enter the home in June and early July. These are the female queen wasps which have been hibernating all the winter, and which in the early summer collect food for their first progeny, the grubs of the workers, which lie in the partly constructed nest. Destruction of the queens means the death of these potential workers, since the grubs will thus be deprived of food. Thus the destruction of one queen wasp by the housewife may mean the disestablishment of the nest and the potential destruction of many hundreds of wasps.

Remedies.

The housewife can destroy the queen wasp either by mechanical means such as with a fly-swat; by attracting them to some sweet sticky material attached to paper, or a jar similar to the devices used in trapping flies; or by spraying them with a contact poison.

Destruction of a nest should be entrusted to the expert. Formalin poured down the hole into the nest is a fairly effective remedy. The surest way is to soak some old rag with a solution of potassium cyanide (1 oz. in 1 pint of water) and plug the entrance to the nest with it. This solution should be handled with the very greatest caution as potassium cyanide is fatal to man even in very small quantities. Such treatment is the most effective means of killing adults, eggs, larvæ, and pupæ, in a wasps' nest.

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ANTS

What are ants?

Ants are small hymenopterous insects well known all over the world for their social habits, their remarkable industry, and their elaborate homes or formicaries. Each community has three types of individual, viz. males, workers or non-fertile females, and the fertile female or queen.

Kinds of ants.

There are at least 4,000 different species of ants, but only two are troublesome in English homes, viz. the tiny red ant (*Monomorium pharaonis*), and the small black ant (*Monomorium minimum*). It is the workers of these species which enter the home to steal the housewife's provisions.

Are ants serious pests?

Ants usually invade a home in great numbers, if at all, in their search for food, especially sweets and greasy substances. They get into everything not hermetically sealed, and into every crevice during their foraging for food.

What harm is done ?

Their swarming over food makes it most unpalatable and unfit for human consumption. They stick in jam and honey, they become drowned in milk, they burrow into bread and cake. During the summer a larder may be perpetually raided by thousands of these creatures, causing continuous spoiling of food.

During which part of its life is it a pest ?

The black and red worker ants are pests in the home during their adult life.

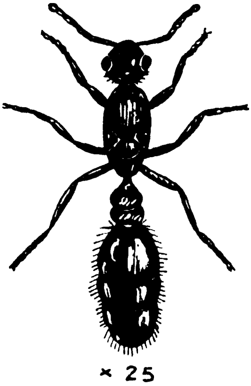

FIG. 95.—Worker Little Black Ant, female.

What does an ant look like ?

The body of the little black ant is distinctly divided into the head, the thorax, and the abdomen (fig. 95). The *head* has a pair of well-developed feelers which are extremely sensitive; a pair of large strong jaws; a pair of compound eyes and three simple eyes. The *thorax* has three pairs of walking legs, and in males and fertile females wings are present (fig. 96); the workers are wingless. The *abdomen* is very characteristic, for it consists of two parts, the anterior stalk-like region (the pedicel) formed of one or two segments each of which has a button-like knob on the upper part, and the lower posterior region. The latter is formed of about five segments, is ovoid in shape, and is called the " gaster." The ovipositor in both fertile females and workers is modified to form a stinging organ.

The *black ant* is about $\frac{1}{16}$ in. long and appears as a tiny black speck. The *red ant* is almost the same size but is distinguished by its light yellow colour.

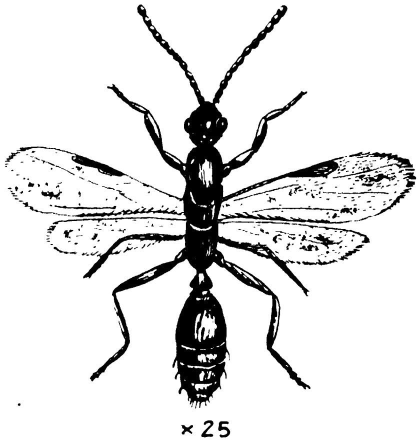

FIG. 96.—Winged Little Black Ant, male.

What are the habits of ants?

Hundreds of ants live together in a colony and form a nest (formicary) which is usually a series of chambers communicating with one another and with the outside world. Each nest is founded by a fertile female, the queen, whose business is to lay eggs. In the early part of her adult life she has wings, which enable her to fly away when she first emerges from the pupa, but after pairing with a flying male she loses her wings, settles down in an innermost chamber of the formicary, and proceeds to lay eggs. Worker ants which hatch from the eggs feed the queen and the young larvæ. They invade the home in search of food which they carry to the formicary. The workers also take care of the larvæ and pupæ by carrying them to different chambers in the formicary according to variations of temperature and humidity. When a stone is upturned to reveal ants hurrying with small white objects, it is larvæ and pupæ which they are carrying in their jaws in an attempt to put them in a place of safety.

The red ant often makes its nest in close proximity to the house, under floors, in walls, in old boxes, or under a stone near a doorway. It eats any of our food, but also attacks other insects, and is reported to destroy bed-bugs. Plant lice, which are serious garden pests, are actually protected by the ants, and even taken to the formicary and maintained for the sake of a sweet secretion which they exude and which the ants like.

The wingless ants commonly seen are the workers, for the flying ants are the fertile males and females. After pairing has taken place the females lose their wings and settle down to become queens, each founding a new colony. The males die immediately after pairing.

Life-history.

The minute eggs are placed in separate chambers in the formicary by the queen, and they hatch out very quickly into whitish-grey footless maggots. After a series of moults the larvæ become quiescent pupæ which, in the case of the red and black ants, have no cocoons but are protected by the workers until they emerge as adult ants. Even after emergence the workers assist them to straighten their limbs and lead them about the formicary until they are fit to go on a foraging expedition.

How to prevent this pest.

An infestation of ants is difficult to control, especially the varieties which occur in tropical countries. If an infestation of red or black ants occurs in English homes it is usually the larder that is raided. If all food is temporarily removed elsewhere, and the place thoroughly cleaned so that no remnants of food remain, the ants will cease to come and will seek their food elsewhere. If the place of entry into the house can be traced (this is often the tiniest crack), a small sponge soaked in sweetened water and placed near the entry will attract the ants until the pores of the sponge become filled with ants. The sponge should then be dropped into boiling water and the process repeated. All cracks and crevices in floors and walls, especially in the larder, should be filled in. Naphthalene flakes or powdered borax scattered around the entry will act as a deterrent.

Remedies.

The only certain way of getting rid of ants in the home is to locate their nest and destroy it and all its contents. To aid in locating a nest a white powder can be used to track the runs which the workers take from home to nest. An effective way of destroying the whole of the contents of the nest is by pouring about two tablespoonfuls of carbon bisulphide down the entry to the nest, and covering with earth. The poisonous vapour being heavy penetrates to the inmost recesses of the nest. Another means of destroying a nest, which should only be used by an experienced person, is to throw a lighted match on the carbon bisulphide after it has been poured down the entry. The resulting explosion destroys nest and inmates. This is not a suitable remedy for the housewife to take unaided, owing to the extremely inflammable nature of carbon bisulphide. She can, however, pour boiling water repeatedly down the hole leading to the nest, but this does not always lead to quick certain destruction. If the nest cannot be located, she can resort to the trapping of the worker ants in the following way. Jam jars lightly coated inside with treacle are placed at suitable points in the ant runs, located by means of a white powder. The worker ants are attracted to the jars which quickly become charged with trapped ants; further armies of ants appear from the nest in search of their comrades, and themselves become trapped. After some time this so denudes the nest that the queen either dies of starvation or moves her quarters with a few remaining workers to a safer place.

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CHAPTER XX

MITES AND SPIDERS

MITES WHICH INVADE THE HOME ACCIDENTALLY

The Red Spider (Bryobia prœtiosa)

What is the red spider ?

This spider is really a mite belonging to the group commonly called the spinning mites, which are common pests in the garden. It shows more similarities with the spider than with the mites, and hence its name. *Bryobia prœtiosa (prœtensis)*, known as the red spider, brown mite, gooseberry mite, red apple mite, apple-stem mite, is usually found in the garden but occasionally invades the home.

Is the red spider a serious pest ?

This mite sometimes enters the home accidentally for no definite purpose. If present at all, it appears in enormous numbers, and often swarms in foliage near the house.

What harm is done ?

A swarm of red spiders in a room causes great annoyance and alarm to a housewife, but as far as is known no harm is done to household equipment, food, or anything else in the home, although things may occasionally be covered with the pest. Much damage is done in a garden to plants and trees by these mites, especially in early spring when they attack the young buds.

What does the red spider look like ?

The body is oval, reddish-brown in colour, and $\frac{3}{10}$ in. long. The mouth parts are adapted for sucking, and the first of the four pairs of walking legs are very long in proportion to the other three pairs (fig. 97).

What are the habits of the red spider?

The red spider is a horticultural pest and the female usually lays her eggs on plant stems or tree bark, those laid in the autumn passing the winter in this habitat. The eggs hatch in the spring, and the miniature adults (nymphs) grow by feeding on plant juices. When the adult mites swarm into a house they do so quite accidentally from nearby foliage by crawling up the sides of the house and in through cracks, open windows, and doorways.

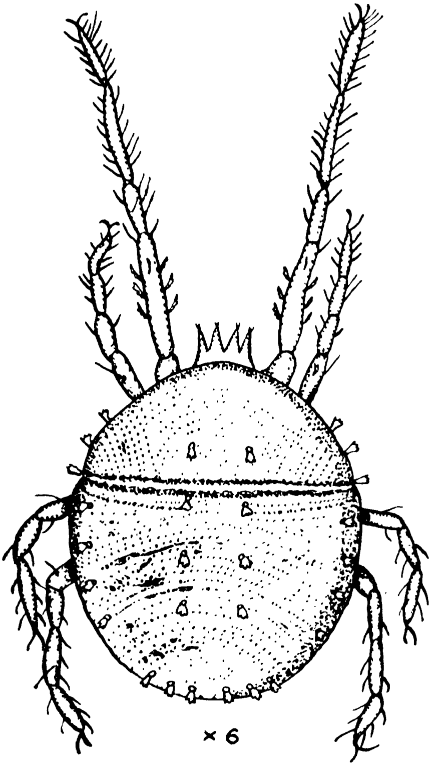

FIG. 97.—The Red Spider. (After Patton.)

Life-history.

There is no metamorphosis and thus no pupal resting stage. The eggs hatch out into larvæ, very similar to the adults, at the approach of spring. The larvæ moult, and the nymphs grow and moult for an unknown number of times until the adult size is attained.

How to prevent this pest.

If plants and trees near the house are known to be infested they should be sprayed with an emulsion of paraffin (¼ lb. soft soap, 1 gallon of water, and about ¼ pint of paraffin oil). If a swarm of mites has entered the house then the best remedy is to fumigate the room by burning sulphur at the rate of 3 lb. for a room 12 ft. square. The room must be carefully sealed, all metal goods removed, and the room left sealed for at least twelve hours.

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MITES WHICH ATTACK FOOD AND EQUIPMENT

Flour- and Cheese-Mites

What are food-mites?

Some mites invade the home for the purpose of getting nourishment, which they obtain from the housewife's provisions. They increase in numbers very quickly, and in a very short time overrun foodstuffs such as flour, farinaceous foods, raw sugar, cheese, and smoked meats, especially ham. These mites belong to the family Tyroglyphidæ, and are usually referred to as the *food and forage mites.* They have long bodies almost twice their breadth, and four pairs of fairly long walking legs each with a single claw. Several of them have a remarkable stage (the hypopus) following the first nymphal stage in the life-history. In this stage the creature possesses some sucking discs on the under-surface, and in this condition it can tide over adverse conditions of temperature, humidity, and food supply. It is in this stage that transference from one foodstuff to another takes place.

Kinds of food-mites.

There are several kinds of mites which attack food. Those commonly found in English homes are *Tyroglyphus* (*Aleurobius*) *farinæ*, often called the flour-mite, *Tyroglyphus longior*, and *Tyroglyphus siro*, the cheese-mite.

Are food-mites serious pests?

The flour-mite is often found in flour and farinaceous foods in great numbers, especially in flour of a certain moisture content and in the warmer months of the year. Not only are innumerable living mites present, but also eggs, nymphs, cast nymphal skins, and excrement foul the food. *Tyroglyphus longior* and *Tyroglyphus siro* are the mites found in cheese and sometimes in smoked meats such as ham, and even in farinaceous foods. They foul these foodstuffs, reducing the cheese to powder wherever they have tunnelled and left excrement.

What harm is done?

Infested flour becomes sour and unfit for use, developing an unpleasant musty smell; tracks of the mites can be seen on the surface of the flour. It is thought possible that disturbances of the human intestine may result from eating infested farinaceous food. Stilton and Cheddar cheeses are often infested with mites causing tunnels and holes to appear, which are filled with dead bodies of mites and their excrement. Such cheeses lose market value. In one cheese (Altburger) *T. siro* is actually introduced to give it a special flavour; when this cheese is eaten a large proportion of the "food" consumed consists of living mites. The consumer gets the flavour, but also possibly incurs digestive disturbances at the same time.

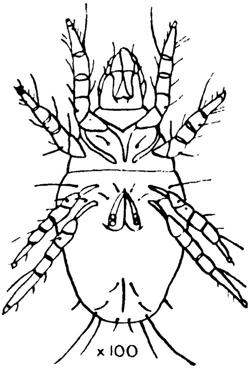

FIG. 98.—Adult Flour-Mite, female, ventral view. (After Patton.)

During which part of its life is it a pest?

These food-mites are pests during the whole of their life-history, since all stages make our food their nourishment.

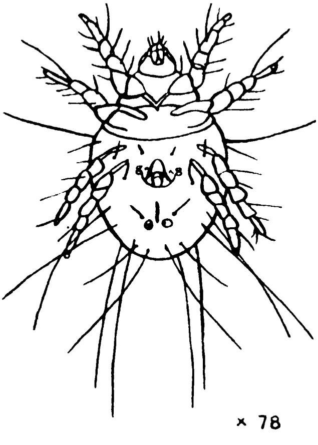

FIG. 99.—Adult Cheese-Mite, male, ventral view.
(After Esdaile, after Newstead and Morris.)

What do food-mites look like?

T. (*Aleurobius*) *farinæ*, the flour-mite, is a very small creature with a rounded abdomen, which is separated from the cephalothorax by a constriction. This lies between the second and third pair of legs; the legs are all of uniform length (fig. 98).

T. longior, the cheese-mite, has a body covered with hair-like bristles (fig. 99). *T. siro* is similar except that the hairs are simple. Both have a constriction between the cephalothorax and the abdomen.

The hypopus (fig. 100), found in all food-mites except *T. siro*, is an intermediate stage between the first and second nymphs. It has a hard body, four short legs not adapted for walking, several sucking discs on the underside of the body, and no mouth nor mouth parts.

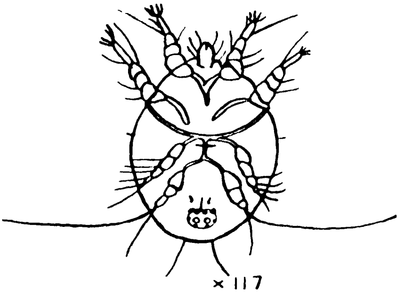

FIG. 100.—Hypopus of Cheese-Mite, ventral view. (After Esdaile, after Newstead and Morris.)

What are the habits of food-mites?

The adults tunnel their way through the food, eating some of it and depositing their excrement in it. The females lay eggs, scattering them singly in the food, which hatch into larvæ. These miniature adults eat and moult, and the nymphs which emerge ultimately form hypopi. This stage can live for several weeks without food, and its hard chitinous covering protects it from injury and from changes of temperature and humidity, all of which might otherwise destroy it. The period of inaction is not always determined by lack of food since hypopi are often surrounded by food, but temperature and humidity have a great influence on the length of time before the hypopus moults and releases the next nymph. It is in the hypopus stage that the pest is transferred from one foodstuff to another. It secures transference to a better food supply by adhering by means of its suckers to some fly, moth, mouse, or other creature which visits the food and then passes to other foods, leaving the hypopus in the new habitat.

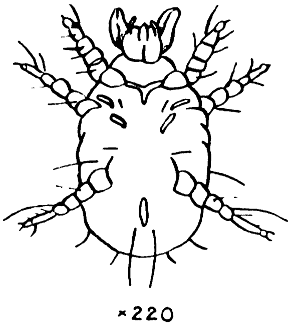

FIG. 101.—Larva of Flour-Mite, ventral view. (After Esdaile, after Newstead and Duval.)

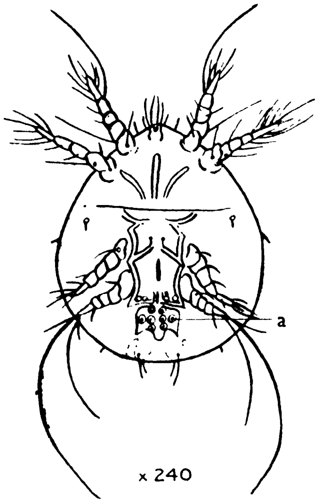

FIG. 102. -Hypopus of Flour-Mite, ventral view, showing (*a*) suckers. (After Patton.)

Life-history.

Development is direct for there is no pupal stage in the life-history of the food-mites. In a warm temperature (65–70° F.) an egg may develop into a mature egg-laying adult in seventeen days, but if temperatures are lower this period is lengthened. The female flour-mite lays up to 30 eggs, about three daily; these are smooth white oval bodies $\frac{1}{200}$ in. long. The larva (fig. 101) has three pairs of legs, and hatches in about four days; it eats and grows and quickly liberates the nymph, which has four pairs of walking legs. The hypopus into which the nymph passes remains in this state for a varying length of time (up to some months) according to conditions. In the flour-mite there are two kinds of hypopi produced, one motile and the other non-motile. The former (fig. 102) is the one able to attach itself to other animals or objects and be transported, but the non-motile one has no power of fixing itself to a disseminator, and relies on the distribution of flour into smaller sacks and bags as a means of being transported. The cheese-mite (*T. siro*) does not pass through a hypopus stage.

How to prevent this pest.

Mites are difficult to get rid of once they have taken possession of a larder. They very easily enter a larder either on food infested when purchased, blown in with dust, especially in the hypopus and adult stages, or carried on clothes or on other pests such as flies. To prevent these mites living in any stage the larder must be kept cool and dry. The humidity of the larder or food cupboard is an all-important factor in the prevention of this pest. Mites require a moisture content of at least 11 per cent., and in an atmosphere drier than this the mites find difficulty in maintaining life; not only do nymphs and adults dry up completely, but eggs are prevented from hatching. In a warm moist place where the moisture content is 13 per cent. or over there is a rapid increase in the number of mites. Food should thus be stored in a cool dry place to prevent mite infestation.

Remedies.

Infested food must be burnt, but this does not remove any quiescent stages which may be in dusty crevices in the larder. Ordinary cleaning of the larder does not destroy these resting forms, and although food has been removed from an infested larder for several weeks, it must be remembered that hypopi can rest for several months before resuming activity. Thus the only safe way to eradicate the pest is to fumigate the larder.

It must be emptied of all food, effectively sealed, and exposed to the fumes of burning sulphur at the rate of 3 lb. to a room 12 ft. square. After leaving for at least twelve hours, the larder is thoroughly ventilated, after which food can be safely stored once more.

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The Furniture-Mite (Glycyphagus domesticus)

What is the furniture-mite ?

This mite belongs to the same family as the flour and cheese mites, viz., the Tyroglyphidæ, but is distinguished from them by the absence of a constriction between the cephalothorax and the abdomen, and also by the body hairs which are feathery in this mite.

Kinds of furniture mites.

As far as is known, only one mite with feathery body hairs, *Glycyphagus domesticus*, frequently invades the home. It is called the *furniture or house mite*, because it is often found in upholstered furniture as well as in food. Several other varieties of *Glycyphagus* are very occasionally found in houses.

Is the furniture mite a serious pest?

This mite infests material used in the stuffing of upholstered furniture, such as cotton-fibre, hair, Algerian fibre; it also infests straw and several foodstuffs such as sugar, flour, and cheese. If present at all, there are usually countless numbers of the pest.

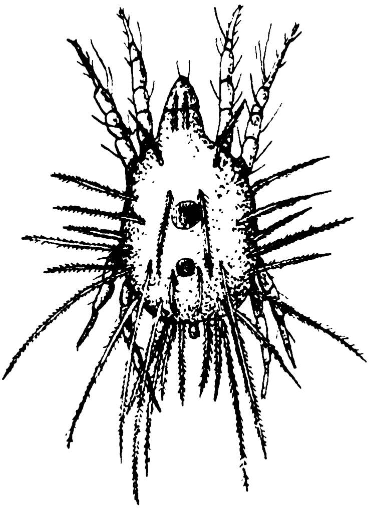

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FIG. 103.—Adult Furniture-Mite, dorsal view.

What harm is done?

If the stuffing of a piece of furniture is infested with the mites they may spread on to the outside covers of the furniture, to cushions, carpets, and even the walls of the room. Although causing consternation, no damage is done to the woodwork or fabric, nor is disease carried by these mites. Persons whose occupation is the handling of quantities of foodstuffs like sugar, which may be infested with this mite, are liable to suffer from a skin disease known as *grocer's itch.*

During which part of its life is it a pest?

The mite is a pest throughout the whole of its life.

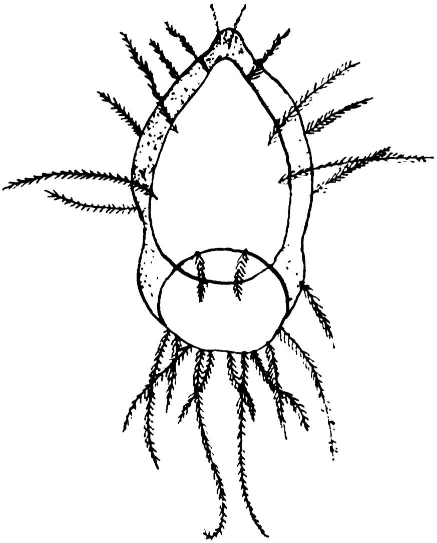

FIG. 104.—Encysted stage of Furniture-Mite.

What does a furniture-mite look like?

The adult is a small white oval creature about $\frac{1}{50}$ in. long with no transverse groove across the body. Several long, straight, feathery, hair-like bristles protrude from the body in all directions (fig. 103).

What are the habits of the furniture-mite?

Little is known about this mite except that it seems to flourish in damp surroundings. Furniture in an unused damp room which has fires very infrequently is likely to harbour this pest. Occasionally swarms of the minute white specks appear on the fabric of the upholstery of furniture, which suggests that the mites were in the stuffing and only needed the necessary extra moisture for them to become active and breed. Infested stuffing may be used inadvertently, but the pest does not make itself apparent until it has been in a damp atmosphere for some time. The green Algerian fibre used for stuffing furniture is often infested.

There is no hypopus stage similar to that of the flour-mite, but instead the creature passes into an encysted state (fig. 104). It occasionally loses its legs and becomes an oval body; a tough nymphal skin affords protection. What causes this encysted state is unknown. In this state the mite is readily blown about, and in this respect it resembles the non-motile hypopus of the flour-mite.

Life-history.

It is known that development is direct, as is typical of mites, and that there is a peculiar non-motile encysted stage.

How to prevent this pest.

Dryness is the all-important factor in keeping this pest in check, for like all its kind it cannot withstand desiccation. This mite is present in practically all homes, storehouses, warehouses, and shops, usually in an encysted state if conditions are dry. If the atmospheric moisture content rises to about 12 per cent. the pest makes itself evident. Before using Algerian fibre to stuff furniture it should be very carefully examined by shaking it over a black background, to see if any minute white specks fall out.

Remedies.

If an infestation occurs then most stages will be destroyed if subjected to a temperature of 130° F. to 150° F. for two hours. There is no doubt that the best remedy for infested furniture is thoroughly to clean it and the whole room and contents, if possible with a vacuum cleaner, wash all wood with water containing a disinfectant (carbolic), and keep the room as hot as possible for a time. This treatment should be repeated at frequent intervals in order to destroy all stages of the mite. Rooms tending to be damp should receive frequent heating.

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MITES WHICH ATTACK MAN

General remarks.

There are several mites which attack man from time to time and puncture his skin in their search for food. This causes painful irritation, and in not a few cases skin complaints result. The following are some of the mites attacking man. The adult *Demodex folliculorum*, which has an elongated worm-like body, sometimes lives in the sebaceous glands of human skin and is associated with " blackheads " which form in connection with acne. The mite causes no actual disease, and is so small as often to be overlooked. The larvæ of the harvest mites, or bugs, attack exposed human skin and cause painful swellings. The adults feed on plants and lay their eggs in them, and the larvæ hatching out frequently pass to human skin. The mite *Pediculoides ventricosus* causes " itch," a skin disease prevalent in workers dealing with seeds, grain, straw, etc. The mites feed on larvæ of insects and on juices from plants and seeds, but occasionally they attack man and pierce his skin in order to obtain blood. In a few hours these bites cause serious skin eruptions, and workers unloading grain may take the pest home and transfer it to other members of their household. The mite which causes harm to man's skin is the *itch-mite* (*Sarcoptes scabei*), which is responsible for the disease known as *scabies*.

What is the itch-mite ?

This mite is a member of the *Sarcoptes* mites, which have rounded bodies and wrinkled skins. The itch-mite in all stages of its life-history lives in burrows in the human skin, causing scabies.

Kinds of itch-mites.

The variety of itch-mite which infests man is *Sarcoptes scabei*, commonly called the itch-mite because an infestation causes intense irritation.

Is the itch-mite a serious pest ?

The female mite burrows in the skin making twisted irregular tunnels up to ½ in. long; each tunnel contains a female mite, excrement, and developing eggs. The mite exudes an irritant secretion which not only causes intense irritation to the infested person but also causes conical pustules to arise along the furrows.

What harm is done ?

The mites are particularly active at night when the body is warm under the bedclothes. The itching causes much loss of sleep and a tendency to rub and cause lesions in the skin. The pustules appear and ultimately the skin becomes hard and scaly. The broken skin also provides entry for other disease-germs, so that such affections as impetigo and boils may be encouraged to develop. Then, too, if the fæces of lice get into the cracks in the skin trench fever may become established.

During which part of its life is it a pest ?

The itch-mite is a pest throughout the whole of its life.

What does the itch-mite look like?

The extremely minute white body in the female is about $\frac{1}{80}$ in. long, and on magnification looks somewhat like a tortoise (fig. 105). The male is much smaller and has a tougher skin. The four pairs of walking legs are very short and stumpy and terminate either in suckers or in long bristles. The female has suckers on the first two pairs, the male on all except the third pair of legs.

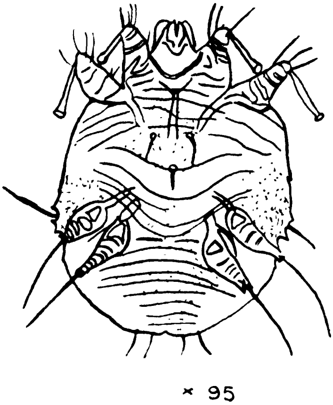

FIG. 105.—Adult Itch-Mite, female, ventral view. (After Esdaile, after Bourguignon.)

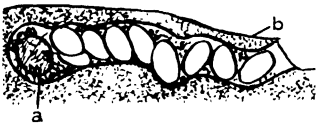

FIG. 106.—Diagram to show (*a*) female Itch-Mite burrowing under (*b*) skin surface. (After Esdaile, after Guiart and Grimbert.)

What are the habits of the itch-mite?

It is the female mite which is responsible for scabies, burrowing into human skin and causing irregular winding tunnels; the smaller male never tunnels, but hides just below the surface of the skin. The females usually burrow near the skin surface in places where it is thin and folded (fig. 106), such as between the fingers and toes. The length of the burrow is determined by the location of the skin and whether or not the mite is disturbed; she usually only burrows at night when the host is warm, and may tunnel about $\frac{1}{8}$ in. each night. She defæcates and oviposits as she moves along, and is reported to lay up to 30 eggs in a burrow. The eggs hatch into larvæ which give rise to nymphs. The young stages tend to burrow further into the skin causing further lesions and the spread of the skin disease.

Life-history.

The eggs hatch in 2–4 days into larvæ, each of which has three pairs of legs instead of four pairs characteristic of the adult mite. The larvæ burrow further into the skin, forming vesicles. At the end of two days, moulting occurs, and the resulting first nymphs each have four pairs of legs. After further burrowing for about two days the first nymphs moult, increase in size, and become second nymphs, some of which are males, and others immature females. A third moult takes place, usually at the end of another two days, and the second nymphs (males) become mature mites ; the second nymphs (females) moult twice in 2–4 days before becoming mature female mites. After pairing, the females make new burrows where they can lay their eggs. It usually takes about a fortnight for the eggs to hatch and become adult female mites. These then tunnel through the skin leaving eggs behind them until, becoming exhausted, they die.

How to prevent this pest.

It is important to be able to recognize the early symptoms of scabies before too much mechanical injury is done by the burrowing of the mites, and before irritation is set up by the poisonous secretion. The mites are transmitted from person to person by contact of skin or clothing; blankets in particular can harbour a live mite for as long as a fortnight. If there is irritation of the skin it must be carefully examined to see if a burrow can be detected. If the irritable part of the skin is stretched the twisted burrow can be seen, and the mite shows up as a white spot inside it. If only one or two burrows are seen, then they can be opened with a sterilized needle and the mite removed. Burrows are, of course, more easily seen in a fair skin than in a dark one.

Treatment of scabies.

If an infestation of mites occurs in the skin, the person and all clothing and bedding must be immediately isolated and everything disinfected. It is not enough for clothing to be washed in the ordinary way, but all garments must be sterilized by adding a disinfectant to the washing water.

The safest way to kill all mites in clothing is to subject it to heat, and some sanitary authorities have special heat disinfestors for the treatment of clothing and bedding infested with the personal pests of man.

The skin should be washed in water containing a disinfectant followed by the application of some substance which will destroy the mites, their eggs, and young forms. Sulphur in the form of an ointment is one of the best sarcopticides.

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SPIDERS WHICH INVADE THE HOME

What are spiders ?

Spiders are Arachnida with a soft-bodied abdomen which has 2-3 pairs of spinnerets responsible for the secretion of the silken threads used in the making of the characteristic webs.

Kinds of spiders.

Two kinds of spiders which tend to invade the home are *Tegenaria domestica* and *Tegenaria derharmii*, the house spiders.

Are house spiders serious pests?

These arachnids do not harm man, his food, or his equipment, but their webs with accumulations of dust and flies look unsightly if left undisturbed in corners of the house, and suggest a lack of cleanliness in the home.

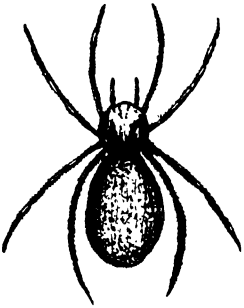

FIG. 107.—The House Spider, much enlarged.

What does a spider look like?

The cephalothorax is covered with a shield of chitin; the oval abdomen is soft-bodied. The mouth parts are adapted as poison claws and feeling organs, and the four pairs of legs are well developed for running (fig. 107). On the underside of the abdomen are situated depressions containing some leaf-like structures in which blood circulates. These are the breathing organs, and each pit-like depression is a lung book. The female spider is much larger than the male.

What are the habits of house spiders?

The spider makes a loose untidy web in a corner in order to catch and hold some insect; the spider then extracts the juices from the living prey and so gets nourishment. The female lurks at the back of the snare reached by a small opening through which both the male spider and the unsuspecting prey enter. After pairing, the female usually eats the male and then lays her eggs in a cluster. She then leaves her nest and proceeds to make another. The eggs hatch out into miniature adults and feed on the entrapped insects until they are fully grown. They then leave the old snare and each female spins a new one.

How to prevent this pest.

Strict attention should be paid to cleanliness in the home and all webs should be destroyed before the female has had time to lay eggs.

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CHAPTER XXI

RATS AND MICE

RATS

What are rats?

Rats are four-footed mammals classed with mice, rabbits, hares, etc., as Rodents; their gnawing habit and their special chisel-shaped front teeth are characteristic features.

Kinds of rats.

There are two kinds of rats which frequent our homes, viz. *Rattus rattus* (the black, old English, ship, or Indian rat), and *Rattus norvegicus* (the brown, Norwegian, Hanoverian, or common rat). The former is less prevalent in Great Britain than the latter at the present time, except in the ports. The water vole, often called the water rat, lives in water and sometimes wanders in the fields, but does not invade the home. The musk rat or musquash is somewhat similar to the water rat and is now a serious agricultural pest, but causes no trouble to the housewife in the home. This rat was introduced into England a few years ago and has quickly established itself as a menace to the farmer.

Is the rat a serious pest?

The rat is the most serious of all pests, and the British housewife does not always realize the menace the rat is to her home and her family simply because the creature is active only at night. It is the most injurious animal in this country, and man, by his enterprise on the one hand and his carelessness on the other, has encouraged the rat to get food and shelter and to breed and rear young so easily, that it is estimated there is one rat per person in this country. Human food is the rat's food;

fleas which suck their blood suck human blood; the rat lurks in man-made drains and sewers. Despite improved sanitation and housing in this country the rat population is increasing.

What harm is done?

Enormous quantities of human food are devoured by rats, and it has been computed that a rat eats a pennyworth of food daily. On this basis, and assuming a population of 44 millions in this country, about £66,000,000 of food is devoured yearly by rats in this country alone. The amount of food the rats spoil is infinitely more than that which they eat. Then, too, in order to gain access to houses they gnaw and burrow and do untold damage to property; they jeopardise the foundations of the house; they gnaw through woodwork all over the house and are often responsible for structural collapse. They are known to carry several diseases and are a very real menace to health; the rat is man's most deadly enemy. The number of diseases known to be carried by rats is steadily increasing: plague, trichinosis, rat-bite fever, are definitely known to be disseminated by rats. It is also thought that the rat is a vehicle for intestinal dysentery in man; it is suspected as a carrier for the germ causing leprosy; it is known to carry foot-and-mouth disease in cattle and is the vehicle for conveying influenza in horses from one stable to another and to pit ponies in adjacent mines. It gets everywhere, leaving filth and fæces wherever it goes, and so contaminating any food or utensils in the home.

During which part of its life is it a pest?

Rats become household pests as soon as they are able to search for their own food, which is about four weeks after birth.

What does a rat look like?

Although the names brown rat and black rat are given, they are misleading, as very often the common brown rat, so prevalent to-day, is of a darker colour than the black or ship's rat, which quite often is brown. Other characters distinguish the two kinds of rats, and the Ministry of Agriculture and

Fisheries Bulletin No. 30 (1935) gives the following distinguishing characters between the two species:—

BLACK RAT (*Rattus rattus*) (fig. 108)	BROWN RAT (*Rattus norvegicus*) (fig. 109)
Smaller, of slim build, with sharp muzzle.	Larger, of heavier build, with blunt muzzle.
Ears large, naked, almost translucent, reaching or covering eyes when pressed forwards.	Ears small, hairy, thick, hardly reaching the eyes when pressed forwards.
Tail slender, at least as long as head and body.	Tail stout, never as long as head and body.
Pads on soles of feet relatively large.	Pads on the soles relatively small.
Many slender, grooved bristles in the soft fur. Usually ten teats.	Grooved bristles fewer and more slender. Usually twelve teats.
Adult weight rarely over 8 oz.	Adult weight normally 14-17 oz.

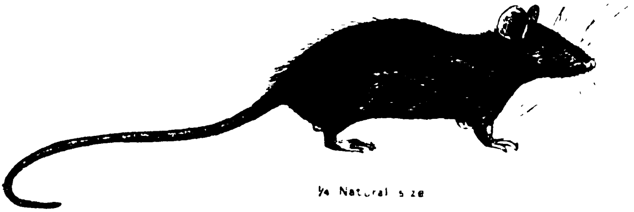

FIG. 108. -The Black Rat (*Rattus rattus*).

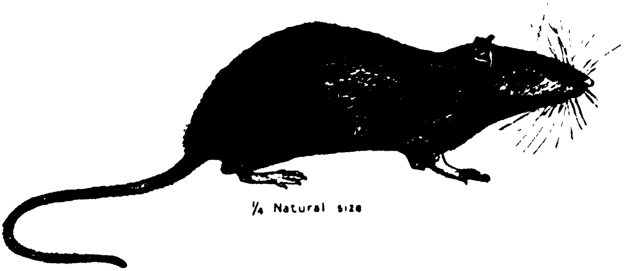

FIG. 109.—The Brown Rat (*Rattus norvegicus*).

What are the habits of rats?

In several ways the two kinds of rats are similar. Both are nocturnal creatures and go on definite runs at night to places where they can obtain food. They are extremely wary and sensitive creatures, and have exceedingly sensitive whiskers and feet. By daybreak they have returned to their nests, which are concealed holes or burrows lined with rags, paper, and feathers. Here they sleep by day, and the females give birth to their young, which are nursed in the nest for nearly a month. The rats establish nests near to a food supply, and when this is exhausted, or if they find a better one, they make a new nest.

With their chisel-shaped front (incisor) teeth they can gnaw through almost anything, even lead pipes, brick, and cement. The gnawed material is not swallowed, for the rat has a remarkably sensitive pad of skin which meets behind the gnawing teeth and is responsible for the selection of material suitable as food. Since the rat has its taste-organs at the front of the mouth, in particular on the pad of skin, only palatable food is selected, and much that is gnawed never enters the mouth. Thus it is that poisoned wood and other substances can be gnawed by rats with no ill-effects, since the rat does not allow the poisoned material to enter the mouth. Only if the pad and taste-organs are destroyed is a poison allowed to enter a rat's mouth, and this fact is of great importance in the destruction of the pest. Rats are omnivorous creatures and in the summer months they rely on food such as small young animals and eggs, which are plentiful out of doors in that season. When autumn comes they migrate near to homes, which they invade nightly in their search for food. Rats do not allow weakly offspring to grow up, but kill and eat any that are injured or of poor physique. Only in extreme starvation does the rat attack man.

Both kinds of rats harbour varieties of fleas which can also live on man, and it is known that at least one variety of flea, *Xenopsylla cheopsis*, carries *Bacillus pestis*, the germ responsible for plague.

The brown or common rat is a water-lover. It uses waterways in moving from one district to another, and very often frequents sewers and drains. Often this rat visits a tank of water in a home night after night in its desire for swimming. It burrows and digs very readily in its efforts to find a suitable secluded place for a nest.

The black rat hardly ever burrows but is a strong climber. Thus it is seldom found in cellars and drains, but more often in the cavities of walls and the roof of a house.

Life-history.

Rats are extremely prolific. The female produces litters of 5–14 young, five or six times a year, from the age of about 4 months, that is, before she is fully grown. Since breeding can take place all the year round, but especially in the first half of the year, the number of rats increases with great rapidity despite the onslaught against them. The female very carefully nurses all her helpless young for about a month, after which they are able to forage for themselves.

How to prevent this pest.

The housewife can do much to prevent this pest from getting into her home, although it is beyond her scope to do much in keeping down numbers; this is a matter for the farmer and the public authorities. Every householder should see that the home is rat-proof. All windows and ventilators should be protected, and stack-pipes should be caged at the open ends, and any drain opening into a sewer should be sealed. In new houses great attention is now paid to foundations and basements, concrete usually being used.

The disposal of all refuse should be carefully attended to since rats not only are omnivorous in their feeding habits, but they use household refuse such as paper for their nests. Thus the housewife should burn daily as much refuse as possible, especially edible material. Failing this, she should keep all refuse adequately covered till collected by the sanitary authority. Many housewives do not realize the encouragement they give to rats by having overflowing dustbins and by leaving remnants of food out of doors for pets and birds.

Means of extermination.

The Rats and Mice (Destruction) Act, 1919, enforces every occupier of land, including buildings, to take steps to destroy rats and mice on their property and to prevent it becoming infested. In England conditions during the last war were such that the necessity for food storage made this legislation imperative. If rats are known to be in the vicinity of the home the housewife must take her share towards extermination of the pest.

There are several methods of destroying rats, viz. by trapping, hunting, snaring, poisoning, gassing, and by encouraging their natural enemies if the home is in the country. It is known that the common kestrel, the barn owl, the magpie, the weasel, and the stoat, are all natural enemies of the rat and should not be destroyed by the farmer and gamekeeper. The housewife can resort to the use of traps, some of which deal effectively with the rat if bait such as dry bread is used. There are also many rat poisons on the market and, if used according to instructions, especially those containing red squill, are quite efficacious.

What to do in a serious infestation.

In a serious infestation, the housewife should engage the services of a professional rat-catcher. Each man has his own way of catching and destroying the pests: some use ferrets, others rely on traps, and so on.

MICE

What are mice?

Mice, like rats, belong to the Rodent group of mammals.

Kinds of mice.

There are several varieties of mice, most of which live out of doors. Occasionally a field mouse strays accidentally into the home in the autumn, but the common household pest is a larger mouse called *Mus musculus*, the common house mouse (fig. 110).

Is the mouse a serious pest?

The majority of English homes shelter the mouse from time to time, and if only a stray one appears not much notice is taken by the housewife. Often, though, several mice appear together, and these consume considerable quantities of food and foul much more.

What are the habits of the mouse?

In both general habits and breeding habits the mouse is similar to the black rat. It usually makes its nest behind skirting boards and under floor-boards and large pieces of furniture.

How to prevent this pest.

If a house is made ratproof then it is also mouseproof. Any small holes, especially those near the skirting boards, must be effectively filled with cement. The mouse has the same natural enemies as the rat, and these should be encouraged and not destroyed, as is sometimes the case.

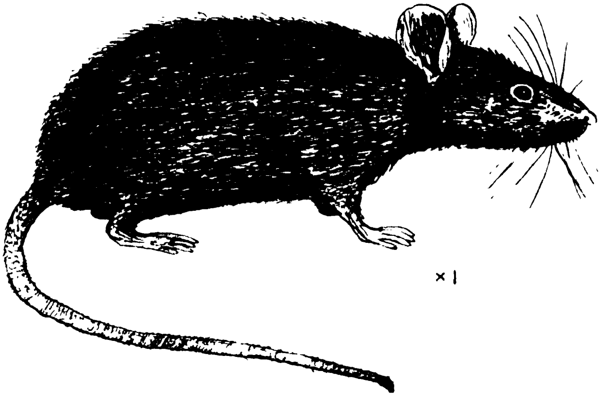

FIG. 110.—The House Mouse (*Mus musculus*).

Means of extermination.

Food of any description must be kept in mouseproof receptacles, or put beyond the reach of mice. No refuse must be left unprotected. Mice will not stay in a house where food is unobtainable. Traps baited with food unlike that in the vicinity can be used; mice are not so wary of traps as are rats.

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KEY TO CONTENTS

A = Description of pest
B = Description of life-history.
C = Effect of pest on man.
D = Methods of control.
E = Good illustrations.
* = If cost is under 1s. 6d.

CHAPTER XXII

MOULDS

What are moulds?

Moulds are saprophytic fungi which live upon decaying plant matter and are chiefly responsible for causing the removal (by rotting) of the remains of all plants including vegetables; they help in keeping the surface of the earth free from litter. Unfortunately some of them attack food (fruit, vegetables, bread) and equipment (wood) made from plants, and so are formidable pests in the home. The fungal moulds prey upon household goods in order to get nourishment and are especially detrimental to the housewife's stores of jam, cakes, bread, fruit, cheese, and to the woodwork and walls in her home.

Kinds of moulds.

Mucor mucedo (the pin-mould) is the common mould which attacks bread, jam, fruit, and fruit juices; *Penicillium glaucum* also lives on some fruits (it is the blue mould of jam), but it is more often found on cheese and on the layer of fat which is sometimes used over bottled fruit to prevent decomposition since, like so many fungi, *Penicillium* can use oils and fat for food. It is this characteristic which causes the two species of Aspergilliaceæ, namely *Penicillium glaucum* and *Eurotium* (*Aspergillus*) *herbariorum*, to be often found on damp walls causing green, black, brown, and yellow patches. *Merulius lacrymans* is the fungal mould found living on wood, and the variety found in the home is sometimes called *domesticus*; this fungus causes "dry rot." Other fungi which also cause rotting in wood are *Poria vaporia* and *Coniophora cerebella.* The latter is usually found in association with *Merulius,* which often provides the necessary moisture for *Coniophora.*

Are moulds serious pests?

If conditions of moisture and temperature are suitable, the moulds which attack foods like bread, jam, fruits, vegetables and cheese make it unpalatable; apart from the appearance being spoilt an unpleasant flavour is usually produced, and most attacked foods become soft and rotten. The saprophytic fungi which attack wood in the home cause floors, joists rafters, skirtings, to become soft and spongy with numerous splits across the grain, often called " cross shakes." The infestation quickly spreads if conditions are favourable, that is if some infested rotting wood is left in or near the home, and the wood in the house, especially flooring, is inadequately ventilated. Apart from the rotting of the wood a strong smell rather like decaying fish is often present if the infestation is severe. Some moulds which live on the walls and paint of the home cause it to become discoloured, and if the walls are papered the paper tends to peel off.

What harm is done?

All moulds cause the housewife much unnecessary expense and trouble. The constant appearance of moulds on food means that much is wasted. Dry rot in the woodwork of a home often involves much expense and labour in the renewal of the infected wood. Accidents sometimes occur when floors are attacked, by their sudden collapse under a heavy weight; structural collapse of the building may occur without warning. The following signs in a house indicate the possible presence of dry rot : cracks in ceilings and uneven floors indicate rot in rafters; floor-boards giving way indicate rot in floors; broken or displaced tiles or slates of a roof at the eaves indicate rot at the ends of rafters; sinking of lead gutters in a roof allowing pools of water to collect suggests rot of bearers; wood screwed together coming apart means that the screw has lost its hold due to rotten wood; often there is a peculiar musty somewhat fishy smell. Some moulds live on the oil, size, wood-pulp or paste used on walls, and the discoloration, the peeling-off of paper, the salty patched appearance of a distempered wall, all of which result from mould attack, means more frequent decorating of the house, with all the expense and trouble this entails.

What does a mould look like?

Very little of the mould can be seen since most of the plant is penetrating the substance from which it is obtaining nourishment. In all cases a branching network of fine colourless threadlike tubes (hyphæ) spread like roots in the wood, plaster, or food, and this feltwork of interwoven hyphæ (the mycelium) cannot be seen (fig. 111). It is the mycelium, however, which does the actual damage, for the hyphæ repeatedly branch and affect more and more of the substance on which they are living. The erect threads which bear the fruiting organs are what the housewife sees on the surface of her food or walls. In *Mucor* the mycelium is just apparent on the surface of the bread or jam, giving a fluffy cobwebby appearance. The erect hyphæ are more obvious, each with its swollen end. Each swelling is a sporangium which contains hundreds of minute structures called spores. The sporangia are black in colour just before they burst to liberate the ripe spores, hence the name pin-mould. In *Penicillium* (the blue mould) there is an extensive mycelium and special erect hyphæ which are often termed conidiophores or sporophores. These arise in great profusion and branch considerably, giving a brush-like appearance (fig. 112). The terminal branches have constrictions which cause chains of conidia (spore-like structures) to form. *Eurotium* (*Asper-*

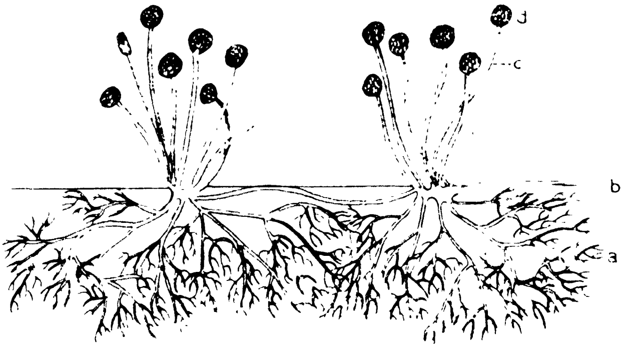

FIG. 111.—Diagrammatic drawing showing Mucor growing on bread. (*a*) Feltwork of hyphæ in bread ; (*b*) surface of bread ; (*c*) erect threads ; (*d*) fruiting organ (*sporangium*). (Much enlarged.)

gillus) has also an extensive felted mycelium with each erect hypha, called a conidiophore, swollen at the free end, from which several conidia are budded off. *Merulius lacrymans* also consists of a network of hyphæ within the wood which are responsible for taking of nourishment from it and causing it to rot, and a number of hyphæ which stretch across wood, plaster, and other surfaces; there are no erect hyphæ, however, and so this fungus is never obvious like those previously referred to. The surface hyphæ are very much branched and are so woven together that sometimes cordlike strands, sometimes thin sheets, sometimes thickish pads, are formed. The spores are produced in cuplike fructifications on the superficial creeping hyphæ.

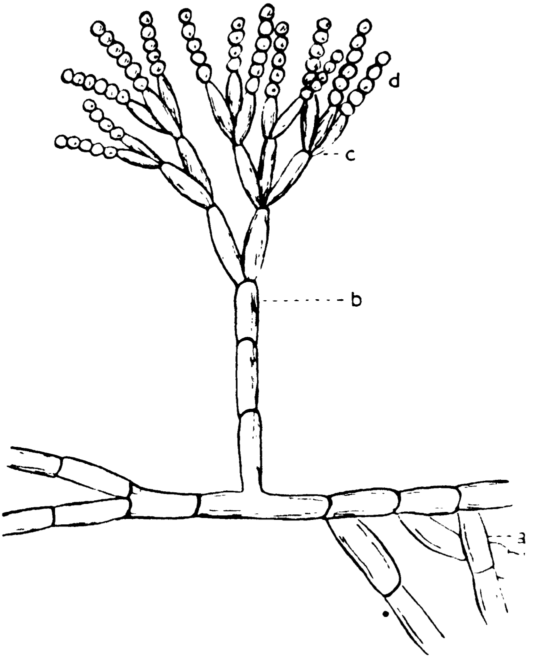

FIG. 112.—Diagrammatic drawing of Penicillium (blue mould) showing (*a*) hyphæ ramifying in jam or cheese ; (*b*) erect hypha ; (*c*) branching hyphæ ; (*d*) chain of fruiting structures. (Very much enlarged.)

What are the habits of moulds in the home ?

(*a*) *Merulius lacrymans.*—The hyphæ forming the mycelium in the wood secrete juices containing ferments which are exuded on to the wood, making it damp. If ventilation is poor the dampness persists and spreads as more juices are exuded by the growing hyphæ; the ferments in the juice absorb any nourishment in the wood and a brown residue is left. Whilst the moisture is there the wood retains its shape, but sooner or later drying occurs. The fungal threads, having exuded their juices and taken all the nourishment from the wood in their vicinity, send new branches to nearby wood and proceed to make this damp. The original threads cease to exude and so drying of the wood results. The wood, which is fissured in all directions, forming the typical "cross-shakes," becomes a brown, powdery, crumbling, dried material. During the time that juices are being exuded by the threads another fungus *Coniophora*, often gets established. This fungus requires much moisture for development, but if some *Coniophora* spores alight where *Merulius lacrymans* has established itself, then this other fungus helps in the deterioration of the wood. The superficial hyphæ of *Merulius*, woven into cords, sheets, or pads, can spread over surfaces where there is no nourishment. It is this habit of creeping over brickwork, wires, tiles, and sometimes through mortar, that accounts for an infection starting in an ill-ventilated floor or skirting-board of a house, and spreading throughout the house. The spores formed in the fruit bodies on the surface mycelium are set free as the ripe fructification bursts. The ripe spores help to form the invisible dust of the air. They can be blown about for several months and can still retain the ability to germinate and produce a thread if given suitable conditions. They require some moisture for germination, so if they alight on wood saturated with water or wood already attacked by such a fungus as *Coniophora*, the spores quickly germinate. The threads can then proceed to branch and form a mycelium.

(*b*) *Mucor mucedo*.—This mould appears on foodstuffs if conditions are warm and damp, for the hyphæ ramify in the food, exuding ferments which convert the foodstuff into nourishing substances suitable for absorption by the hyphæ. These slender tubular structures grow, branch, and send up the erect threads into the air (fig. 111). Each terminates in a sporangium filled with minute round spores with mucilage in between them and the hypha projecting into the sporangial cavity as a central column (fig. 113). The mucilaginous substance swells if moisture is present, and this aids the bursting of the sporangium wall when the spores are ripe. The spores are shot into the air and carried as dust; they are extremely resistant and can be blown about for several months and still germinate if they alight on a suitable substance, and moisture and warmth prevail. Occasionally resistant bodies are formed by this mould if favourable conditions cease to exist. A zygospore is formed, which is a rounded body with a thick black coat. In this condition it can await the return of favourable conditions of moisture and warmth; then the wall splits and a short hypha grows out which bears a sporangium (fig. 114). This liberates several spores which immediately find themselves in favourable conditions of moisture, temperature, and a food supply, and so germinate and produce hyphæ (fig. 115). The resistant zygospore is formed by two hyphæ swelling at the ends, which come together. Each swollen end is cut off from its thread and the swellings become one globular mass of protoplasm (fig. 116).

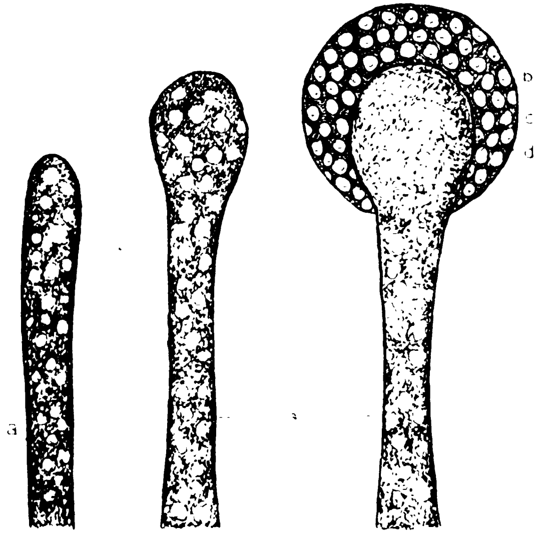

FIG. 113.—Diagrammatic drawing of three stages in the development of a Sporangium in Mucor. (*a*) Erect hyphæ; (*b*) sporangium; (*c*) spore; (*d*) mucilage. (Much enlarged.)

(*c*) *Penicillium* (fig. 112) and *Eurotium.*—These two moulds, which so often live on walls, do so only if moisture is available. So often the walls of a house on the weather side are infected and all walls of old houses, especially the lower part of walls of the downstairs rooms; this is because no damp course is present.

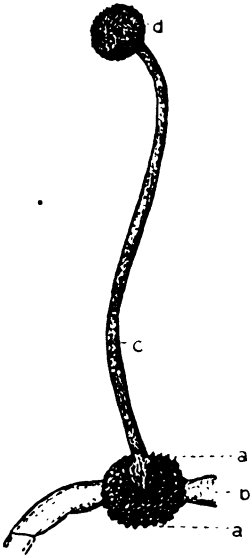

Fig. 114.—Zygospore of Mucor from which is growing an erect fruiting hypha. (*a*) Zygospore; (*b*) creeping hypha ; (*c*) erect hypha with (*d*) sporangium. (Much enlarged.)

How to prevent moulds.

In the majority of the moulds frequenting the house, such as *Mucor*, *Penicillium*, *Eurotium*, *Coniophora*, if moisture is excluded then they cannot grow. Spores cannot germinate and existing hyphæ do not branch. Thus all food such as bread, cakes, cheese, jam, fruit, fruit-juice, should be kept in a cool dry place. Furthermore, all this food should be protected from contact with any dust by being adequately covered, so that any spores are prevented from having access to the food. This fact should be remembered in jam-making; immediate covering after putting the jam into jars is the safest way to protect jam from spore infection. Adequate precautions should be taken to prevent damp walls since these encourage *Penicillium* and *Eurotium*. Apart from having an adequate damp-course (a constructional detail now enforced by law), further precautions can be taken as follows. Creeping plants and foliage should not be allowed to grow up the outside walls of a house, especially on a weatherside wall; it is also inadvisable to have garden soil adjacent to the walls of the house, but if this is so care must be taken to keep the level of the soil below that of the damp-course. In the case of *Merulius*, which can make plenty of its own moisture to support its activities, it is often dry wood which is affected, but only because of inadequate ventilation. The need for a sufficient supply of air cannot be over-emphasized, and a sufficient number of air ventilators should be allowed under the ground floor of a house. The moisture content of the wood must be kept below 20 per cent., hence care should be taken in the washing of floors badly covered by linoleum. Unless carefully dried, excess water oozes between the many cracks in the linoleum and causes the wood under the linoleum to become saturated with moisture, so giving ideal conditions for the dry rot fungi. In solid floors a layer of bitumen should be put over the concrete foundation before the wood is laid, for although the concrete may have been carefully mixed some moisture is liable to penetrate through from soil to wood. In the case of solid floors the housewife need be less apprehensive of dry rot. For not only are solid floors seldom covered except by a few loose rugs, but they are scarcely ever washed with water.

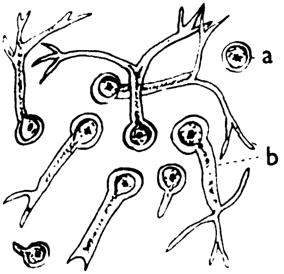

FIG. 115.—Germinating spores of Mucor. (*a*) Spore ; (*b*) hyphæ. (Much enlarged.)

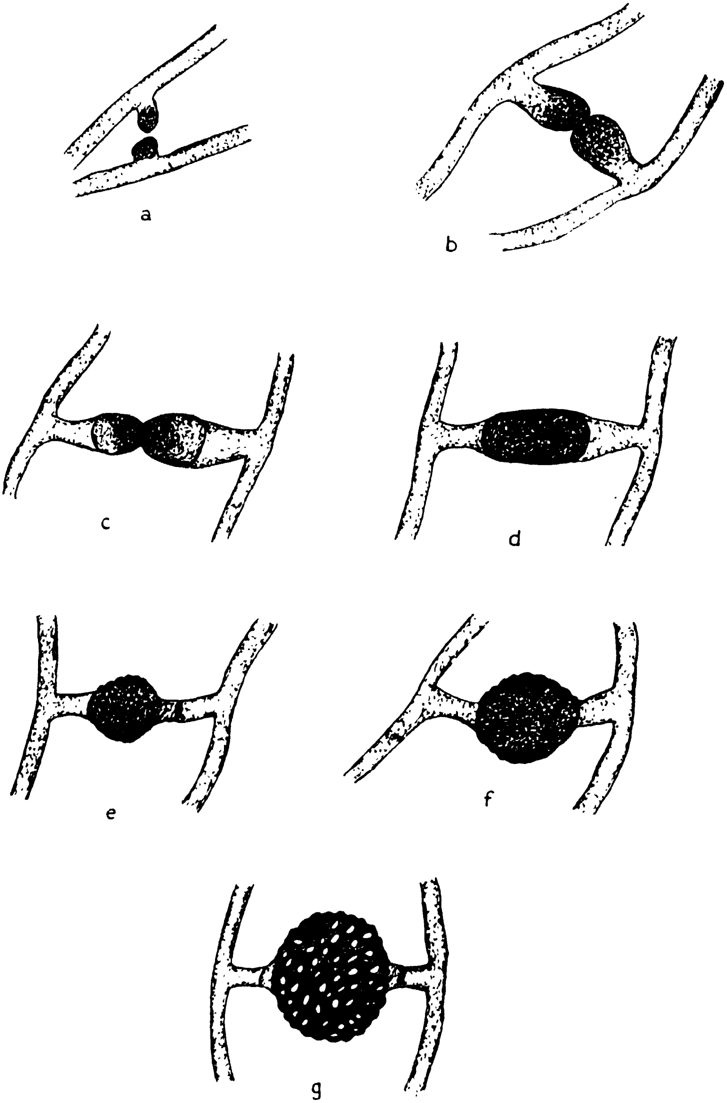

FIG. 116.—Stages showing the development of a Zygospore in Mucor. (Much enlarged.) (*a*) Early stage showing two hyphæ swelling opposite one another; (*b*) stage where swollen ends are touching; (*c*) stage with swollen ends cut off from their respective hyphæ; (*d*) fusion of two swellings to form one; (*e, f*) Swelling becoming a globular mass of protoplasm (zygospore); (*g*) zygospore with a thick coat ready to break away.

All these factors tend to render the wood too dry for the encouragement of the dry-rot fungus. It is essential in the building of a house for great care to be given to questions of ventilation of wood work and the laying of floors; it is also essential to use timber which is not infected.

Remedies.

If food is infected with *Mucor* it must immediately be burnt and the containers washed with water containing a little formalin followed by washing in the ordinary way. These containers, whether jars, bread-crocks, or tins, should be very thoroughly dried before more food is put into them.

If papered walls are infected then the paper must be stripped off and burnt immediately. Stripped walls and discoloured distempered walls should be thoroughly washed with some fungicide such as formalin or magnesium silicofluoride. If the latter is used a 5 per cent. solution of commercial magnesium silicofluoride in water is effective. Since the substance is acid, and attacks metals and glass, it should be mixed in a wooden container and the brush should not have a metal brush holder. This fluoride is non-volatile, acts as a filler to any tiny cracks in the wall, makes a waterproof covering, and also kills any fungal growth. It discolours light blue and green shades of distemper, however, but is suitable for use on bare walls and on paint. After an application several days must elapse before either papering, distempering, or painting. Formalin is satisfactory to use, but since it is so volatile it does not effect a permanent cure; the expense of washing a wall at intervals is not great, however, since formalin is so cheap. About one part of formalin to seven parts of water should be used. A wall which is continually affected can often be cured by water-proofing the outside of the wall and thus preventing the access of the essential moisture. This can be done by painting with any of the silicate preparations marketed for this purpose.

If dry rot is infecting wood in the home a joiner must be called in and all the rotten wood, chips and shavings removed and immediately destroyed by burning. All sources of dampness must be remedied and the new wood used must be free from infection. If rot is suspected in the wood being used, a sharply pointed tool driven about ¼ in. into the wood enters easily if rot is present and is easily withdrawn. Wherever possible the wood must be protected from possible infection by having a preservative such as a coating of creosote or magnesium silicofluoride. This not only sterilizes the surface which may be contaminated with spores, but prevents further possible infection.

Technical advice on the subject of dry rot can be obtained by applying to the Forest Products Research Laboratory, Princes Risborough, Aylesbury, Bucks.

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KEY TO CONTENTS

A = Description of pest.
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D = Methods of Control.
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GLOSSARY

The definitions contained in this glossary are those applying especially to the subject matter of this book.

ABDOMEN—The hind part of the body in jointed-legged animals and of the trunk region in animals with a backbone.
ANTENNÆ—The first pair of appendages in insects usually called feelers.
ARTHROPODS—Animals with jointed feet, segmented bodies, and an outside skeleton.

CEPHALOTHORAX—The anterior division of the body consisting of a coalescence of head and thorax as seen in spiders and mites.
CHEMICAL—A substance manufactured or obtained from natural sources.
CHITIN—A hard substance made by the cells of the skin of arthropods making the skin tough.
CHLOROPHYLL—The green colouring matter in plants associated with the manufacture of food.
CHRYSALIS—The resting stage of an insect just before the adult emerges.
COCOON—The envelope or case which encloses certain insects during the resting stage in their development.

DEFÆCATE—To pass out waste (fæces) from the digestive tube.
DIAPHRAGM—A muscular partition which separates the thorax from the abdomen in mammals.
DORMANT—Inactive.

ECDYSIS—The casting of the skin—usual in all arthropods which have a tough outer covering.
ELYTRA—The horny front wing covers found in beetles.
ENDOSPERM—A special part of the seed containing stored food which lies within the seed-coat but outside of the young plant (embryo).
ECTOPARASITE—A living thing which is attached to the outside of another different living thing from which it steals nourishment.
EXCREMENT—Waste discharged from the body.

FÆCES—Waste passed out from the digestive tube.
FUNGUS—Plants that do not contain green colouring matter and so do not make their own food (e.g. moulds).

GENUS (Pl. GENERA)—A name used in classifying animals and plants; it indicates a group of one or more closely related species.
GERMINATE—To sprout.

HABITAT—The region or locality where a living thing is commonly found.
HALTERES—Balancing structures in the place of the second pair of wings in certain insects (flies).
HEARTWOOD—The inner part of the wood of a tree-trunk where the sap and water have ceased to pass along.
HIBERNATE—To remain inactive; some animals pass the winter in sleep.
HOST—The living organism which provides home and food to another living thing and suffers from the partnership.

HYPHA—A long threadlike branching process of a fungus.
HYPOPUS (Pl. HYPOPI)—A stage in the life-history of a mite which can tide over adverse conditions, and during which it is easily carried from one place to another.

IMAGO—An adult insect.
INSECT—A small animal with a jointed body, having a distinct head, thorax, abdomen, three pairs of jointed legs, and usually wings.
INSECTICIDE—A preparation for killing insects.
INSTAR—A stage in the development of insects which hatch as immature adults and become more like the parent at each moult.
INORGANIC—Something not the result of living processes but occurring quite apart from living matter.
INVERTEBRATE—An animal without a backbone.

LARVA—The young immature form which the egg of many insects hatches into; an active growing stage totally unlike the adult.
LEGUMINOUS—Plants such as peas and beans which produce legumes as fruits.
LETHAL—Deadly.
LIFE-CYCLE—The course followed by a living thing in its life.
LUNG BOOKS—Small sacs with folds of tissue—the respiratory organs of spiders.

MAGGOT—The footless worm-like stage in the development of an insect like a fly.
MAMMALS—Animals which feed their young with milk from the mother's body and have hair.
MANDIBLES—The second pair of appendages in an insect; they are situated near the mouth, have serrated edges, and tear and bite food.
METAMORPHOSIS—Transformation: a process whereby some insects pass through abrupt changes in their development from the egg to the adult form.
MIGRATE—To remove from one place or habitation to another.
MOTH—A scaly-winged insect with feathery feelers and which flies about at night.
MOULT—To shed or cast.
MYCELIUM—The body of a fungus which is a network of thread-like tubes.

NYMPH—A young stage of an insect which is structurally very similar to the adult. Found in insects with direct development.

ORGANIC—Something to do with living matter.
ORGANISM—A living thing, plant or animal.
OVIPOSIT—To deposit eggs.
OVULE—The small part within a flower which must be fertilized by a pollen grain before a seed is formed.
OXYGEN—A colourless odourless gas essential to living things; present in air.

PARASITE—A living thing which lives in or on another and steals food, either that of its host or it eats the host itself.
PHOTOSYNTHESIS—The manufacturing process by means of which plants with green colouring matter can build up their own foodstuffs during sunlight from products in the air and water from the soil.
PHYLUM—A group into which the plant or animal kingdom is divided.
PLANTIGRADE—Walking on the sole of the foot.
POLLEN—Fine yellow powder composed of cells made by flowers; each cell must unite with the ovule of a similar flower in order to form a seed capable of giving rise to a new plant.

PUPA—The quiet inactive stage present in many insects before they become mature adults.

PUPARIUM—The last larval skin which hardens to form a case enclosing the pupa. Is found in insects like the fly.

REGURGITATE—To pass food back from the stomach and mouth.

SAPWOOD—The outer wood of tree-trunks where the sap and water circulate during life.

SEED—The fertilized ovule from which a flowering plant will grow.

SPECIES—A collection of animals or plants having members closely resembling one another.

SPIRACLE—An opening on an insect's body leading into one of the breathing tubes (trachea).

SPORE—A minute part of a plant which can give rise to another plant without being fertilized.

SPORANGIUM—An organ containing an indefinite number of spores.

TRACHEA—A passage or tube by means of which air is circulated in an insect's body.

VERTEBRATE—An animal possessing a backbone.

VOLATILE—Quickly evaporating.

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